DEPARTMENT OF THE INTERIOR

FINAL ENVIRONMENTAL STATEMENT

FES 73—19

Proposed

1973 OUTER CONTINENTAL SHELF

EAST TEXAS GENERAL

OIL AND GAS LEASE SALE

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Prepared by
UREAU OF LAND MANAG

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Summary

( ) Draft (X) Final Environmental Statement
Department of the Interior, Bureau of Land Management, Division of Marine Minerals

1. Proposed Oil and Gas Lease Sale, Outer Continental Shelf, Gulf of Mexico.
   (X) Administrative ( ) Legislative Action

2. One hundred twenty-nine tracts (697,643 acres) of OCS lands are proposed for leasing action. The tracts are located offshore Texas. If implemented, this sale is tentatively scheduled to be held in late spring, 1973.

3. All tracts offered pose some degree of pollution risk to the environment and adjacent shoreline. The risk potential is related to adverse effects on the environment and other resource uses which may result principally from accidental or chronic oil spillage. Each tract offered is subjected to a matrix analytical technique in order to evaluate significant environmental impacts should leasing and subsequent oil and gas exploration and production ensue.

4. Alternatives considered:

   A. Hold the Sale in Modified Form

   B. Withdraw the Sale

      1) increased oil imports
      2) increased onshore oil and gas production
      3) increased nuclear power
      4) increased use of coal
      5) increased hydroelectric power
      6) modification of FPC natural gas pricing
      7) oil shale production
      8) wellbore stimulation for recovery from known deposits
      9) increased LNG imports
      10) synthetic natural gas and oil
      11) energy conservation
      12) combinations of alternatives

   C. Delay Sale

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5. Comments have been requested from the following:

Environmental Protection Agency*

Department of Commerce*
National Oceanic and Atmospheric Administration

Department of Transportation*
U. S. Coast Guard

Atomic Energy Commission*

Federal Power Commission

Office of Emergency Preparedness*

Council of Economic Advisors

State of Florida*
Department of Administration

State of Louisiana
Commission on Intergovernmental Relations
Department of Conservation
Louisiana Wildlife and Fisheries Commission

State of Alabama*
Alabama Development Office

State of Mississippi*
Coordinator for Federal-State Programs

State of Texas*
Office of the Governor

Department of the Interior
Bureau of Sport Fisheries and Wildlife*
Bureau of Outdoor Recreation*
Bureau of Mines*
Geological Survey*
National Park Service*
Office of Oil and Gas*

* Comments or acknowledgement received.

6. Final statement made available to the Council on Environmental Quality and the public on April 13, 1973.

   Draft statement was made available to Council on Environmental Quality and the public on January 18, 1973.

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Note:

This final environmental statement has been prepared pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969.

The regulations to which reference is made throughout this environmental statement are 30 CFR Part 250 and 43 CFR 3300, and Geological Survey OCS Orders Nos. 1 through 12 - Gulf of Mexico. The OCS Orders for the Gulf of Mexico have been appended to this statement (see Attachment G). Although too bulky to append here, the CFR's cited may be obtained from the United States Department of the Interior.

I. DESCRIPTION OF THE PROPOSAL

A. Background of Proposal

"For most of our history, a plentiful supply of energy is something the American people have taken very much for granted. In the last twenty years alone, we have been able to double our consumption of energy without exhausting the supply. But the assumption that sufficient energy will always be readily available has been brought sharply into question within the last year. The brownouts that have affected some areas of our country, the possible shortages of fuel that were threatened last fall, the sharp increases in certain fuel prices and our growing awareness of the environmental consequences of energy production have all demonstrated that we cannot take our energy supply for granted any longer.

A sufficient supply of clean energy is essential if we are to sustain healthy economic growth and improve the quality of our national life. I am therefore announcing today a broad range of actions to assure an adequate supply of clean energy for years ahead . . .1/"

President's Clean Energy Message
June 4, 1971

1/ U.S., President, "The President's Message to the Congress, June 4, 1971," Weekly Compilation of Presidential Documents, Vol. 7, No. 23, June 7, 1971, pp. 855-866.

The U.S. is the single largest energy-consuming nation in the world, accounting for one-third of the world's total consumption. The growth in domestic demand for electric power and industrial demand for energy has caused a sustained high level of energy demand; from 1960 to 1970 demand increased at an average rate of 4.3 percent per year.

Overall Energy Requirements for the 15 Year Period 1970 to 1985 1/

	1970 Quantity	1970 Percent of energy supply	1985 Quantity	1985 Percent of energy supply
Coal (1,000 short tons)	526,650	20.1	850,000	18.4
Crude petroleum (million bbls)	5,367	43.0	8,600	43.5
Natural gas (billion cu. ft.)	21,847	32.8	38,200	24.3
Hydropower (billion kil. hr)	246	3.8	363	3.7
Nuclear power (billion kil. hr)	19	0.3	1,982	10.1
		100.0		100.0

1/ Dupree, W.G. and J.A. West. 1972. United States energy through the year 2000. U. S. Department of the Interior, Washingtion, D.C. (Dec., 1972).

The President's Clean Energy Message alerted the nation to the possibility of insufficient supplies of clean energy unless prompt action were taken. He proposed measures designed to alleviate the projected short-fall in supply. One of these measures was the development of energy resources on Federal lands and specifically the oil and gas resources of the Outer Continental Shelf. The Department was directed to accelerate OCS offerings of oil and gas leases and to prepare a tentative five-year schedule of lease offerings. On June 15, 1971, the Department complied and made available to the public such a schedule. (Attachment A). This proposed lease sale is the fourth sale identified in this release.

B. Tentative Five-Year Schedule

The tentative schedule is currently being updated and revised within the Department. Improved resource information has been acquire and the overall supporting analysis is being refined in line with the current energy situation. In the development of the first schedule, the Department considered its three leasing objectives; orderly resou development, protection of the environment and receipt of fair market value. These objectives constitute overall policy parameters for the OCS program and consideration accorded to each may vary from one component to another. An analysis was made in broad terms of when,

where, and how much oil and gas acreage to offer for lease. This was done through a review of the national energy situation and the identification of future supply-demand imbalances. Deficits were identified by matching projections of future non-OCS supplies of oil and gas and future OCS production from existing leases with future projected demand. Demand forecasts were made on a regional basis, using the regions of the Future Requirements Committee for gas and the Petroleum for Administration of Defense districts for oil. New OCS sales were proposed in line with helping to meet the deficits. Different alternative schedules were tested with respect to their impact on demand.

These different options were also reviewed from the perspective of receipt of fair market value. The size and frequency of sales can induce or inhibit a competitive market which in turn affects the Government's receipt of fair market value. Currently, in order to promote competition and sufficient capital for bonus payments and development of leases, two general sales of 300,000-600,000 acres each are scheduled per year.

The policy decision under which the current tentative lease sale schedule was determined that lease sales would generally be within 300-600 thousand acres in size was based upon analyses that the range is large enough to generate sufficient interest in a sale and not too large to reduce competitive levels unreasonably. The

matter of the appropriate size of sales is the subject of continued study within the Department's managment objectives of orderly resource development, protection of the environment, and receipt of fair market value.

Under the tentative five-year schedule, an environmental impact statement based upon detailed analysis of all appropriate data will be prepared for each proposed OCS oil and gas lease sale included in the five-year schedule. Detailed studies designed to analyze environmental impacts of proposed OCS lease sales have been initiated for the Mississippi-Alabama-Florida area of the Gulf of Mexico. In addition, an environmental analysis of the cumulative impact of OCS oil and gas operations is being initiated.

Prior to any decision to lease OCS lands in the Gulf of Alaska and Mid-Atlantic areas, broad planning studies of the environmental, natural resources, mineral, economic and other regional factors must be made available and carefully analyzed. An in-house data reconnaissance study on the Mid-Atlantic area 1/ has been completed and one on the Gulf of Alaska is in progress. These studies will only serve as the first step in our data gathering efforts. Until the results of these studies, and others that may be necessary, are fully evaluated, no decision to initiate leasing

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1/ Library Research Project Mid-Atlantic Outer Continental Shelf (Reconnaissance), Dept. of Interior, Bureau of Land Management, December, 1972.

programs in these areas can be made. In addition, the question of respective Federal and State OCS jurisdiction in these off-shore areas is currently in litigation. Resolution of this issue is necessary before a decision on leasing actions can be made.

C. Activity, Environment, and Impact from the Five-Year Schedule in the Gulf of Mexico

1. Proposed Sales

Sales tentatively included in the five-year schedule (excluding possible Gulf of Alaska and Atlantic areas) are:

1. Gulf of Mexico Drainage (held November 1971)
2. E. Louisiana General and Gulf of Mexico Drainage (held September 1972)
3. Louisiana General and Gulf of Mexico Drainage (held December 1972)
4. East Texas General and Gulf of Mexico Drainage (this proposed action)
5. Alabama, Mississippi and Florida General and Gulf of Mexico Drainage
6. Louisiana and East Texas General and Gulf of Mexico Drainage
7. Gulf of Mexico Drainage
8. Louisiana and Texas General and Gulf of Mexico Drainage
9. Gulf of Mexico Drainage
10. Gulf of Mexico General and Drainage

2. Development

The following table indicates the intensity of activity that will be required in order to develop the hydrocarbon reserves believed to underlie areas included in the five-year schedule in the Gulf of Mexico.

		This Proposed Sale	Current Status	Increment: 1/ 5-yr. Schedule	1976 Status
a.	Acres under lease (mil.)	0.558 2/	4.0	2.6-3.6	5-6 3/
b.	Reserves to be developed:				
	- oil (bil. bbl.)	0.3-0.6	3.2	2.5-5.0	
	- gas (tcf)	5.4-7.6	24.0	20-40	
c.	Remaining reserves:				
	- oil (bil. bbl.)				2.75-4.0
	- gas (tcf)				35-45
d.	Wells	350-450	10,544	3,500-4,500	13,500-15,500
e.	Platforms	80-140	1,935	800-1,400	2,600-2,900
f.	Miles of Pipelines	100-300	6,019 4/	1,020-3,000	7,000-9,000
g.	Terminals	1-2	74	14-28	90-100
h.	Storage Facilities	2-3	82	16-32	100-120

1/ All figures are for development over the life of the leases issued during the five-year period.

2/ Estimated that 80% of the acreage proposed for offering in this sale will lease.

3/ This assumes that some leases will have expired or will have been relinquished.

4/ Includes approximately 3,100 miles of common carrier pipeline.

3. Environment

The coastal zone of the Gulf of Mexico is richly endowed with estuaries and coastal marshes. Over 200 estuarine systems extend from Florida Bay and the famous Ten Thousand Islands of the Everglades to the hypersaline Laguna Madre of the Southwest Texas coast. It is estimated that there are about 12.7 million acres of estuary and coastal marsh habitat in the five states bordering the Gulf of Mexico. This is about 45 percent of the total estuary and coastal marsh area in the contiguous 48 states, about two-thirds of the coastal marshes and one-third of the estuarine water area. It is this area of shallow estuaries and marshes that makes the Gulf of Mexico so productive of fish and wildlife resources. 1/

From the shoreline of the barrier islands of the Gulf, waters deepen gradually at a rate of about six feet per mile out to depths of about 300 feet, where the gradient increases more rapidly out to the shelf break or continental slope. In some areas the shelf is more than 100 miles wide. The Gulf Coast area lies, generally, in a zone of transition between tropical and temperate weather patterns. The climate is mild (mean temperature 69° F.) and the area receives

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1/ U.S. Congress, Senate, Report of the Secretary of the Interior to the U.S. Congress, the National Estuarine Pollution Study, 91st Congress, Second session, March 1970.

considerable precipitation (55 inches annually). Wind flows are complicated, particularly in the cold months, when the normal track of disturbance traveling west to east lies near the coast.

The Gulf of Mexico is defined ecologically as a high energy system in which the naturally generated energy supply is sufficient to maintain a large and diverse population of plant and animal life. The extensive shallow water area of the Continental Shelf provides a broad expanse of nutrient laden substrate that tends to concentrate commercial species of fish where they can be caught readily.

a. Wildlife

The coastal area in and adjacent to the Gulf of Mexico offers wintering and nesting areas for a large proportion of the waterfowl population of the United States. It is the southern terminal for much of the Central Flyway and both the Mississippi and Atlantic Flyways. Twenty-five National Wildlife Refuges, including 486,780 acres are located in the area. These are distributed as follows:

	National Wildlife Refuges	Acres
Texas	5	131,333
Louisiana	5	232,476
Florida	15	122,971

In addition, 66,250 acres of wildlife habitat adjacent to the refuges have been closed to hunting by Presidential Proclamation.

Each State, including Louisiana, Alabama and Mississippi, Florida, and Texas, also operates several wildlife refuges or management areas adjacent to the Gulf of Mexico.

b. Fishery Resources

The rich, nutrient laden estuaries of the Gulf of Mexico produce an abundance of sport and commercial fish. Major species by type of estuarine dependence are: 1/

	Residents While Juveniles and Adults	Residents While Larvae and Juveniles
Sport Fish	Crabs, Spotted Sea Trout, Oysters, Snook	Croaker, Tarpon, Black and Red Drums, Spot, Mullet, Sand Sea Trout, Whiting, Shrimp, Flounder, Salt Water Sheepshead, Salt Water Catfish, Bluefish, Ladyfish
Commercial Fish	Oysters, Blue Crabs, Spotted Seatrout, Stone Crab	Same as above plus Menhaden but not Tarpon

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1/ The National Estuarine Pollution Study, op. cit., p. 116.

c. Recreation

The Gulf of Mexico offers a wide variety of outdoor recreation opportunities. The recreational resources of the areas are summarized as follows: 1/

Florida

Florida's total recreation shoreline on the Gulf of Mexico is 1,755 miles including 111 miles of public recreation areas and 771 miles of beach. Approximately half of the entire shoreline (840 miles) consists of mangrove swamps or marsh. All water oriented recreation activities are feasible in the area, but swimming and fishing are the most popular.

Alabama

Total recreation shoreline in Alabama is 204 miles including 115 miles of beach and 89 miles of marsh shore and only 3 miles of public recreation areas. Swimming, fishing, sailing and boating are suited to the area and are the most popular recreation activities.

Mississippi

Mississippi's total recreation shoreline is 203 miles including 69 miles of marsh shore and 134 miles of beach. The Mississippi mainland shoreline lies some miles behind a widely broken chain of

1/ All statistics pertaining to outdoor recreation were taken from, Shoreline Recreation Resources of the United States, Outdoor Recreation Resources Review Commission, Report No. 4, 1962.

offshore islands (Petit Bois, Horn, Ship and Cat Islands), which protect the shore from the open Gulf. The area is best suited for such recreation activities as swimming, fishing, sailing and boating.

Louisiana

Louisiana's total recreation shoreline (including Lake Pontchartrain) is 1,076 miles including 819 miles of marsh shore and 257 miles of beach. Fishing, hunting, wildlife study, boating, and related activities are best suited to the area. Swimming is feasible but the nature of most beaches and offshore bottom make them less than attractive. 1/

Texas

Area available for recreation in the Texas coastal zone is 23.3 square miles, or 0.2% of the total land area in the coastal zone. 2/ This recreation area includes 343 linear miles of beach and 359 miles of marsh shore. The shorelines are probably as little developed as any beach areas in the United States. All water oriented types of recreation activity are feasible on the Texas shore.

1/ See also section I. E. "Recreation Resources".

2/ Flawn, P. T. and B. Fisher, 1970. Land-use Pattern in the Texas Coastal Zone. In The coastal resources management programs of Texas, appendices. ed. by J. T. Goodwin and J. C. Mosely, Coastal Resources Management Program, Office of the Governor, Austin.

National Park Service Units 1/

National Park Service units in the Gulf of Mexico area are:

Padre Island National Seashore
Gulf Islands National Seashore
DeSoto National Monument
Everglades National Park
Fort Jefferson National Monument

Potential new areas are:

Suwanee Wild and Scenic River
Jean Lafitte National Cultural Park
Wakulla River National Monument or Wild and Scenic River

In addition to Federal areas, the following National Landmarks are located in the Gulf of Mexico area:

Fort Morgan National Historic Landmark
Fort San Marcos De Apalche National Historic Landmark
Safety Harbor Site National Historic Landmark
Lignumvitae Key Natural Landmark

4. Resource Use and Commercial Activity Related to the OCS in the Gulf of Mexico

The following major activities and resource uses occur on the OCS or are related to the OCS of the Gulf of Mexico.

a. Mineral Industry

The petroleum refining industry and the related extraction industries of Louisiana and Texas have a growth rate several times greater than the national rate for industries of

1/ Current data, National Park Service.

this type. In 1971, Gulf of Mexico OCS operations produced more than 387 million barrels of oil and condensate valued at $1.38 billion ($3.55/bbl.), and about 2.8 trillion cubic feet of gas and over 1.5 billion gallons of gas liquids valued at over $625 million. Total sulphur production on the Outer Continental Shelf was about 1.2 million tons valued at $23.7 million. In addition, 370,406 tons of salt were produced in 1971 with a value of $66,673.

b. Commercial Fishing

The Gulf of Mexico is one of the most productive fishing areas in the United States. In 1971, the commercial fishing catch was 2.097 billion pounds valued at $199.8 million ($0.096/lb paid to fishermen). This catch was 42.2% of the volume and 31.0% of the value of the total United States commercial fisheries catch in 1971.

c. Sport Fishing

In 1970, an estimated 2.4 million fishermen, 12 years and older, spent 25.7 million man-days of fishing in the Gulf of Mexico. Approximately 53 percent of this sport fishing was in the ocean or from beaches and 47 percent was in estuaries. 1/ No projections are available for 1976, but the 1970 level is expected to increase.

1/ Projected from 1965 National Survey of Fishing and Hunting and 1965 Salt Water Angling Survey; U.S. Fish and Wildlife Service, and preliminary 1970 Salt Water Angling Survey, National Marine Fisheries Service.

d. Recreation

In 1970, recreationists participated in 215 million recreation activity occasions 1/ in the Gulf of Mexico area; by 1975 it is expected that recreationists will participate in approximately 250 million recreation activity occasions in this area. 2/ Recreation activities in the Gulf area are, of course, largely water-oriented. Water-oriented recreation is the most popular form of outdoor recreation in the United States. The warm climate of the Gulf of Mexico makes this area very attractive to recreationists both in, and beyond, the region.

Last year's and estimated future visits to National Park Service Units in the Gulf of Mexico are as follows:

	Visits in 1971	Estimated Visits 1976
Padre Island	904,400	1,165,900
Gulf Islands	0	2,052,600
De Soto N. Mon.	135,500	161,600
Everglades	1,293,500	1,428,200
Ft. Jefferson	10,500	20,900

1/ A recreation activity occasion is the participation in a single activity by a single individual.

2/ The above estimates for recreation use are based on data and procedures contained in A New Perspective on Recreational Use of the Ocean, National Planning Association, Winslaw and Bigler. The above estimates are included for the purpose of presenting order of magnitude data and could be subject to considerable adjustment.

e. Shipping

The Gulf of Mexico is subject to heavy shipping traffic. The following is an analysis of shipping traffic (daily distribution in the Gulf of Mexico) 1/.

	All Vessels Over 100 GRT*		
Location	1969	1972	1980
Straits of Florida	19	27	21
Eastern Gulf of Mexico	17	19	17
Western Gulf of Mexico	9	6	10
Mobile Area	62	77	73
Ent. to Miss. R.	18	16	19

*Gross Tons

f. Military Use

Some areas of the Gulf of Mexico are designated by branches of the U.S. Armed Forces to be used exclusively for military purposes, such as practice gunnery, bombing, and rocket-firing ranges. Other areas are designated as dumping grounds for both military and civilian use. A possible restraint on the extent of future offshore oil and gas leasing involves conflicts in some areas between mineral development and high priority uses of the Department of Defense. Some adjustments in Defense "Warning Areas"

1/ A Study of Maritime Mobile Satellites, Vol. I, - Merchant Vessel Population/Distributors Present and Forecast, Automated Marine International, Newport Beach California.

(these are principally testing and training areas) on the OCS and/or development of adequate special oil and gas lease stipulations, where appropriate, will need to be made before mineral leasing in such areas can proceed.

g. Research and Education

Besides applied research in petroleum geology, ocean engineering, commercial fishing, fish farming, and other fields, a number of Gulf States colleges and universities are involved in basic research in the marine sciences. The shoreline and open waters of the Gulf of Mexico serve as an important outdoor laboratory. The following table lists colleges and universities, and degrees offered, that carry out part or all of their field education and research in the Gulf.

An example of this emphasis on field research in the Gulf involves the plans of the University of Texas Medical Center to establish Flower Garden Ocean Research Center 1/. If the University's plans are

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1/ Marine Biomedical Institute, University of Texas, 1971. The Texas Tektite Project: Flower Garden Ocean Research Center, Gulf of Mexico. Misc. brochure, University of Texas Medical Branch, Galveston. 21 pp.

COLLEGES, UNIVERSITIES AND RESEARCH INSTITUTES
UTILIZING THE GULF OF MEXICO FOR RESEARCH AND EDUCATION

Institution	Location	Degree Offered/Research Activity
Univ. of Alabama	Bayou La Batre	Undergrad courses; research
Fla. Institute of Technology	Melbourne	B.S., M.S. in Oceanography
Fla. State University	Tallahassee	M.S., Ph.D. in Marine Biology, Oceanography Ph D. in Geophysical Fluid Dynamics
Univ. of Florida	Gainseville	M A , M.S , Ph.D in main departments with emphasis in Marine Science
Rosenstiel School of Marine and Atmospheric Science--Univ. of Florida	Miami	M S., Ph.D. in Marine Biology Science, Marine Geology and Geophysics, Physical Oceanography, Chemical Oceanography, and Atmospheric Sciences
Nova University Oceanographic Laboratory	Fort Lauderdale	Ph.D in Physical, Chemical Oceanograpny, Marine Biology, Physics (marine emphasis)
Univ. of South Florida Marine Science Institute	St Petersburg	M S. in Marine Science
Univ. of West Florida	Pensacola	M S. Biology--Estuarine, Marine Studies
Louisiana State University	Baton Rouge	M.S., Ph.D in Marine Sciences
Gulf Coast Research Laboratory	Ocean Springs, Miss.	Affiliated with 29 Gulf States Colleges and Universities, M.S , Ph D. in Biological Sciences (marine emphasis)
Institute of Engineering Tech. Miss. State University	State College	Bach. of Engineering Tech (marine emphasis)
University of Southern Miss	Hattiesburg	M.A., M S. in Biology, Geology
Gulf Univ. Research Corp.	College Station, Tex.	Consortium of 21 universities and research institutes of Gulf States, basic and applied research in all areas of marine science.
Univ. of Houston	Houston, Tex	M.S in Biology, Geology, Ph D in Biology (marine emphasis) J D with emphasis in marine law
Lamar State College of Tech.	Beaumont	B S. in Oceanographic Technology
Marine Biomedical Institute	Galveston	Doctoral and Postdoctoral training in marine biomedical sciences
Rice University	Houston	M A , Ph D in Geology, Geophysics, Geochemistry
Texas A & M University	College Station	M S , Ph D in Oceanography, Zoology, Botany, Microbiology, Biology (marine emphasis) M.S. in Marine Resource Management
Texas A & M University Marine Biology Laboratory	Galveston	Basic and applied research in all phases of marine biology
Texas Christian Univ	Fort Worth	M S in Biology, Environmental Science, Geology (marine emphasis)
Texas Maritime Academy Texas A & M University	Galveston	B S in Marine Engineering, Marine Transportation
Univ of Texas at Arlington	Arlington	M.A in Biology, Chemistry, Physics, M S in Geology (all with marine emphasis)
Univ of Texas	Austin	M A , Ph D in Botany, Chemistry, Geology, Microbiology, Physics, Zoology, Engineering, (marine emphasis)
Univ. of Texas Medical Branch at Galveston	Galveston	Teaching and research in marine biomedical Sciences
Univ. of Texas Marine Institute	Port Aransas	Research in marine science, Seaside facility to augment curricula at Arlington, Austin campuses
University of Puerto Rico	Mayaguez	M.S. in Marine Science

implemented, the facility would be located in 80 feet of water about 120 nautical miles SSE of Galveston, Texas. Facilities proposed by the University consist of an offshore platform with laboratory modules, living quarters, power generators, and support facilities. On the coral reef below, there would be placed a Tektite-type undersea habitat.

h. Land and Water Conservation Fund

The Land and Water Conservation Fund was formed to develop and preserve outdoor recreational resources for the benefit and enjoyment of all American people of present and future generations.

Oil and Gas, sulphur, and salt royalties credited to the U.S. Treasury from Outer Continental Shelf operations together with lease rentals and bonuses from OCS lease sales are in turn credited to the Land and Water Conservation Fund in amounts necessary to bring that fund to $200 million for fiscal years 1969 and 1970, and $300 million for 1971 and 1972, as follows:

Fiscal Year	Fund Requirement	Funds From OCS	Per Cent From OCS
1969	$200 Million	$126.9 Million	63
1970	$200 Million	$107.9 Million	54
1971	$300 Million	$210.1 Million	70
1972	$300 Million	$223.7 Million	75

Revenue funding also comes from entrance and user fees charged at designated Federal recreation areas, motorboat fuel taxes, and the sale of surplus Federal real estate.

The Contingency Reserve portion of the Land and Water Conservation Fund is a small percentage of the State's share of annual appropriations, set aside to assist the States in financing half the cost of special situations where a unique and valuable area is endangered by helping State and local governments acquire lands which may otherwise be lost to recreation and conservation purposes.

Grants-in-aid under the Fund program can be made only to the States, their cities and counties, and legal political subdivisions. The Federal money pays half the cost of statewide planning projects, land acquisition and development of facilities for public outdoor recreation. Appropriations to the

Fund also pay land acquisition costs for authorized areas being added to the national system of parks, forests, wildlife refuges, wild and scenic rivers, and scenic and recreation trails.

5. Possible Environmental Impacts from OCS Oil and Gas Development Resulting from Implementation of the Five-Year Lease Schedule

The environmental impact which would result from implementation of the five-year lease schedule can be estimated with fair accuracy only after specific factors related to each sale are known. For example, at least the following information is needed but is not immediately available for sales beyond the offshore Texas area: (a) location of tracts in relation to resources, shipping lanes, recreation areas, refuges, etc., (b) type of expected production, e.g., oil or gas, (c) geologic formations, (d) water depths, (e) expected terminal points for pipelines, and (f) expected size and location of required new storage facilities.

In general, it can be assumed that future impacts of OCS oil and gas lease sales, both favorable and unfavorable, will be greater on the environment, on other industries, and on communities in areas where no previous OCS oil and gas leasing has been undertaken. This is so because new pipelines and

storage facilities must be built, relationships must be developed between existing industries, (e.g., fishing and the oil and gas industry), and new labor forces and new payrolls will be introduced to the areas. In short, incremental impacts, both positive and negative, will be greater than for similar lease sales offshore Louisiana and Texas where offshore and nearby onshore production has been in existence for many years.

The general impacts expected to result from the implementation of the five-year schedule are expected to be similar to those described in this statement for the proposed East Texas OCS lease sale. The following table summarizes possible positive and negative impacts that could occur as a result of implementing the five-year lease schedule. More specific relationships cannot be identified until detailed analysis has been completed for each of the proposed sale areas.

General Summary of Environmental Impacts Which Might Result From OCS Oil and Gas Operations 1/

Impact Sustaining Factors	Impact Producing Factors							
	Debris	Plat-form	Oil Spill	Pipel Const	Storage Facil.	Support Serv.	Labor Force	Prod.
1. Refuges	(-)		(-)	4/	4/			
2. Estuaries	(-)		(-)	(-)				
3. Marshland	(-)		(-)	(-)	(-)	(-)		
4. Beaches	(-)	2/	(-)	4/	4/			
5. National Park Units	(-)	2/	(-)	4/	4/			
6. Com. Fish.	(-)	(-)	3/	5/				
7. Sport Fish.	(+)	(+)	3/	5/				
8. Recreation	(-)	2/	(-)					
9. Shipping		(-)						
10. Regional Economy		(+)		(+)	(+)	(+)	(+)	(+)

1/ The principal type of relationship between impact producing and sustaining factors is indicated by (+) positive impact or (-) negative impact. In some relationships, both positive and negative relationships are possible, in these areas, the type of relationship considered dominant is shown.

2/ Impact will be negative only if platforms are visible, i.e., impact will be on aesthetic values.

3/ Impact of oil pollution on nearshore and estuarine shellfish is negative; impact on open-water finfish and shellfish is not well understood, but oil spills adversely affect sport and commercial fishing activity.

4/ Impacts would be excluded by administrative action, e.g., pipelines or storage facilities would not be permitted in refuges, National Park Units, or on those recreation beaches subject to official regulation.

5/ Impacts would occur during construction stage only.

D. Location and Reserves

The sale area under consideration includes 129 tracts 1/ offshore Texas and Louisiana (from the Galveston Areas east through the East Cameron, South Addition Area). These tracts, if leased, would add 672,643 acres, an increase of about 172% to the current total of 405,134 (as of June, 1972) acres presently under Federal lease offshore Texas. It would also add 25,000 acres, an increase of 0.68% to the total of 3,658,955 (as of June, 1972) acres presently under Federal lease offshore Louisiana. The area is approximately 170 miles long with tracts ranging to 120 miles from shore. Five of the tracts are subject to drainage 2/; and 124 tracts are wildcat, some of which are located in previously developed areas. 3/ The proposed lease sale would be made under Section 8 of the Outer Continental Shelf Lands Act (76 Stat. 462; 43 U.S.C. Sec. 1337.) and regulations issued under that statute.

1/ The tracts are summarized by water depth, distance from shore, and expected type of production in Attachment B. Also see attached map.

2/ Tracts subject to depletion of their oil and gas deposits from wells on adjacent tracts. These tracts are: East Cameron, South Addition, blocks 269 and 335; West Cameron South Addition, blocks 528, 586, and 595.

3/ Tracts that are generally located five or more miles from tracts with established production.

Estimated Recoverable Reserves:

	Estimated Volume 1/	Estimated Market Value 2/ ($million)
Recoverable Oil Reserves	30-60 million bbls.	110-220
Recoverable Gas Reserves	5.4-7.6 trillion cu. ft.	1900-2660

It is estimated that the proposed leases may produce 5,000-11,000 bbls. of oil per day and .75-1.05 billion cu. ft. of gas per day by the sixth year after leasing.

Production from OCS leases in the Gulf of Mexico area during 1971 amounted to approximately 387 million barrels of oil and 2,761 billion cubic feet of gas. This production represented approximately 92 percent and 99 percent, respectively, of all oil and gas produced during the year from OCS lands in the United States.

Production from OCS leases offshore Texas during 1971 amounted to approximately 1.7 million barrels of oil and condensate and 127 billion cu. ft. of gas. This operation represented approximately 0.5 percent and 5 percent, respectively, of all oil and gas produced during the year from OCS lands in the Gulf of Mexico. In 1971, 12.03 percent of domestic U.S. oil production and 12.18 percent of domestic gas production came from the Outer Continental Shelf. 3/

1/ U.S. Geological Survey, Informal Preliminary Staff Estimated, Undated, Unpublished.

2/ Ibid.

3/ See also section VIII.B.2., "Onshore Oil and Gas Production," of this statement.

E. Tract Selection

Having determined through development of the tentative five-year schedule, the timing, size, and location of a specific sale, it must be determined which tracts should be offered in the sale. A call for nominations of tracts is issued by the Department. Industry responds by nominating tracts in which they are interested. With improved seismic, geologic and economic data on the specific sale under consideration, the Department analyzes the past leasing history of tracts under consideration and the nominations themselves and makes an initial identification of tracts to be included in the sale.

1. Responsibilities and Procedures

Responsibility for the initial selection of tracts lies with the field offices of the Bureau of Land Management (BLM) and the U.S. Geological Survey (GS) under guidance as to Departmental objectives furnished by the respective Washington offices.

a. BLM-New Orleans Office (NO) is responsible for furnishing the historical and current leasing status of all tracts nominated and their locations with respect to fairways, anchorage and warning areas, and pipelines. BLM-NO makes preliminary identification of tracts based on the following criteria: number

of weighted and unweighted nominations 1/; need to initiate leasing in rank wildcat areas from an economic standpoint; tract history; nomination patterns; mix of tracts by water depths, distance from shore, and nominators, and through analysis of past environmental statements, those types of tracts that have been deleted from past sales or from which special environmental stipulations were developed.

b. GS-NO is responsible for furnishing technical information including geological, geophysical, engineering, and paleontological information in determination of tracts to be recommended for selection. GS-NO identifies tracts based on the following criteria: need to initiate leasing in rank wildcat areas from a geologic standpoint; drainage tracts or those in imminent danger of drainage; tracts for which companies have presented data for GS inspection and evaluation demonstrating their necessity and desirability for further development; tracts which are most prospective for production; other tracts susceptible to prompt drilling and development.

1/ Unweighted: Nomination of a tract by a single company; counts as one nomination.

Weighted: Nomination of a tract by a group or combine of a number of companies; counts as one nomination.

c. The Washington Office of BLM and GS furnish guidelines which flow from the Departmental objectives: orderly and timely resource development, protection of the marine environment ; and receipt of fair market value for leased marine resources. These guidelines include but are not limited to: recommended size of sale; tracts or areas for special consideration; and information relative to Administrative or Department policy. The Washington Office also reviews the joint recommendation of tracts submitted by the BLM and GS field offices for conformity with these objectives and guidelines.

2. Purpose of the Tract Selection Process

It is intended that by this initial tract selection process, tracts which have the highest geological potential normally will be selected. In response to the Department's call for nominations for the East Texas General Sale, 39 oil companies representing 20 bidding groups nominated approximately 5.2 million acres. From this total, a list of 129 tracts comprising 697,643 acres was selected in accordance with the process described above to be included in the proposed sale.

In order to assess the environmental impact which may occur as a result of leasing these tracts, BLM prepares a draft environ-

mental statement, soliciting a wide spectrum of views from Federal, State, and local agencies, and the public. This environmental statement evaluates the potential effect of the proposed lease sale on all components of the environment of the entire area during exploration, development and operational phases. Pertinent published and unpublished resources reports and evaluations are reviewed and portions are included in this statement. In the case of a general sale a public hearing is held. Through these processes, further modification of the list of tracts may result, or special stipulations may be required for the leasing of certain tracts as will be reflected in the final environmental statement.

F. Offshore Oil and Gas Operations

1. Geophysical Exploration

In order to locate hydrocarbon deposits, the oil industry must analyze the substructure of the continental shelf. The prime objective of the structural analysis is to locate geologic structures, such as local upwarping of the sediments, which are favorable for the accumulation of petroleum. A knowledge of the subsurface geologic environment is also necessary to detect near surface conditions, such as recent faulting or high pressures zones, which are potential hazards to exploration and production operations. Once hazardous conditions are identified, drilling programs are modified to assure safety of operations.

Prior to a call for nomination of lease sale tracts, industry normally conducts regional geophysical surveys of an area of interest. These surveys provide a network of modern state-of-the-art common depth point (CDP) seismic lines or approximately a 4 mile-by-4 mile grid spacing to provide data for reconnaissance mapping. In some cases an even closer 2 mile-by-2 mile line spacing may be used. After the Department issues a call for nominations, industry initiates the collection and interpretation of even more detailed seismic data in order to intelligently nominate potentially productive tracts, and formulate reasonable bid offers.

In seismic exploration, a ship travels along a predetermined path, towing signal generating and recording equipment. The signal generated by the energy source is a series of small amplitude seismic pulses that travel at thousands of feet per second through the water and sediments below, where they are reflected and refracted by the underlying strata. An array of sensitive hydrophones towed by the vessel detect incoming seismic waves which are recorded on magnetic tape. After extensive processing, these recordings are displayed in the form of vertical cross sections. These seismic profiles are interpreted to identify those areas where the sediments are arched, faulted or pierced by salt domes, and where they thicken or thin. By assembling cross sections run in various directions, a three-dimensional picture can be constructed, indicating location, size, and form of geologic structures favorable for oil and gas accumulation. This information is normally displayed in the form of a series of subsurface seismic structure maps.

The U.S. Geological Survey also purchases and interprets state-of-the-art CDP seismic data. The USGS has acquired more than 10,700 line miles of CDP seismic data on the Texas OCS to support the Federal offshore leasing program. These data are located in the High Island, Galveston, and Brazos Areas and all additions thereto, and provide definitive information on the size, shape, and depth of the prominent structural features included in the area of the proposed

lease sale. The structural attitude of subsurface beds from depths of 1500 feet to over 20,000 feet can be mapped to show the relative merits or potential structural traps for oil and gas. Structural information and subsurface maps based on seismic data are the primary technical input to the selection of tracts to be offered for leasing.

In the early years of offshore exploration, the energy source for the seismic wave was explosive charges detonated in the water layer. Because of the hazards associated with the use of dynamite to the seismic vessel, crew, and natural marine life, new equipment and methods have evolved within the last five years and now account for well over 95 percent of marine seismic activity. 1/ In particular, the use of a vibrator system, sparkers, air guns, and gas guns now provide excellent seismic data, with no harmful effect on the marine environment.

In addition to the deep penetration CDP seismic reflection data, the U.S. Geological Survey and some companies purchase and interpret shallow penetration high resolution geophysical data to locate potential geologic hazards such as unstable bottom sediment conditions and fault zones. A typical high resolution data acquisition system is illustrated in Fig. 1. The USGS has approximately 6300 line

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1/ Taken from Testimony of E. O. Bell, past President, Offshore Operators Committee, presented at OCS Public Hearing, Houston, Texas, February 22, 1973.

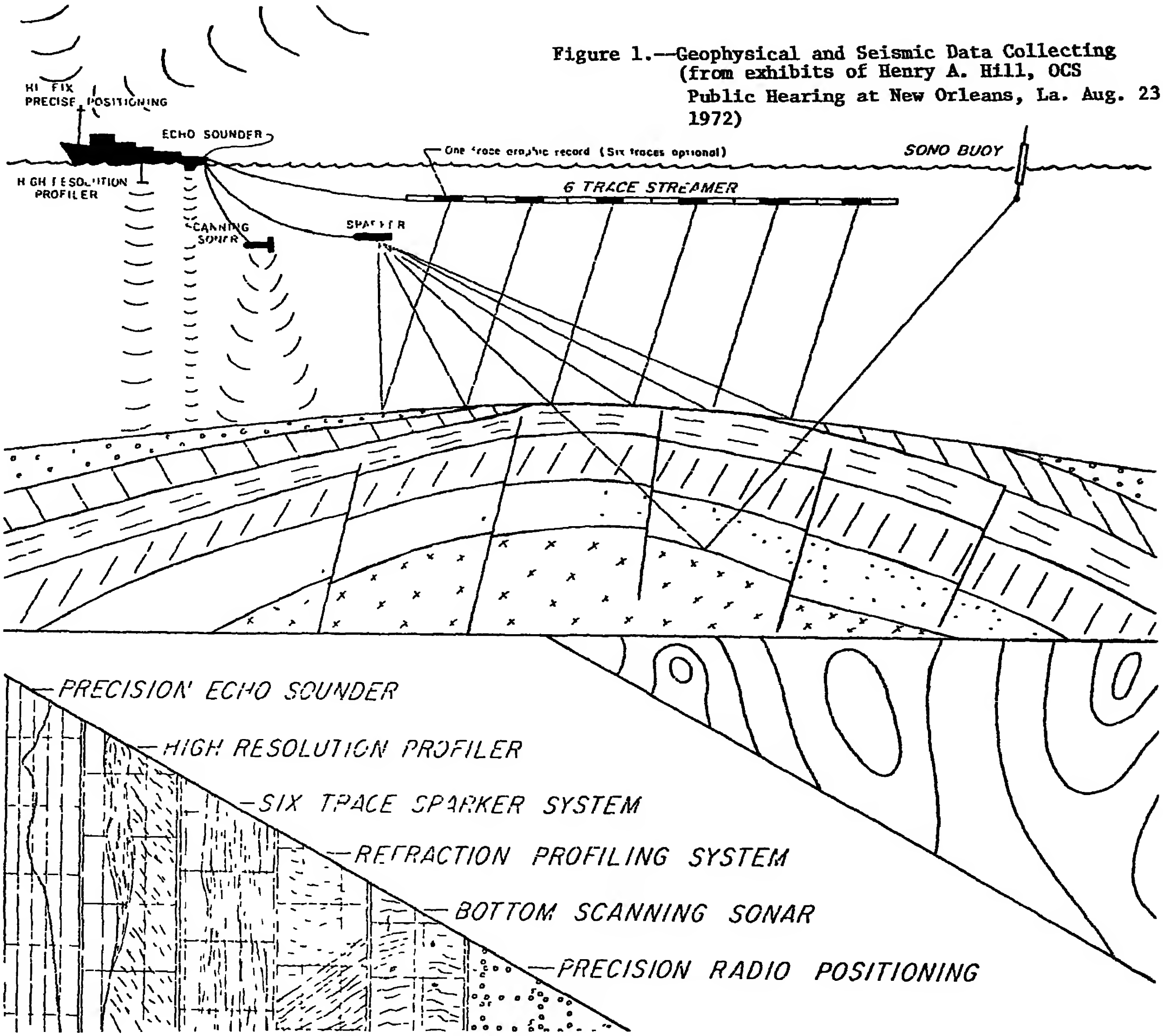


Figure 1.—Geophysical and Seismic Data Collecting (from exhibits of Henry A. Hill, OCS Public Hearing at New Orleans, La. Aug. 23 1972)

miles of high resolution sparker data on a 2x2-mile grid spacing over a majority of the attractive structural features on the East-half of the Texas OCS. These data were acquired using an electric spark energy source having a discharge power of up to 800 joules, generating an acoustic pulse in the fequency range of 200 to 1000 Hz. Acoustic penetration was variable depending on a number of factors, such as bottom and subbottom conditions, combinations of frequency, and power used, etc. Generally speaking, penetration of the Texas OCS was good to 500 feet (±) below the water/bottom interface; the resolution at this depth is approximately five feet.

The USGS has initiated procurement action for the acquisition of an additional 4,000 line miles of high resolution geophysical data over acreage on the Texas OCS to be offered at the proposed lease sale. This program as specified, will investigate the shallow structural and sedimentary environments over the proposed lease tracts. Technical end products from this data procurement will include (1) precision water depth, (2) thickness of unconsolidated sediments, (3) shallow subbottom (0-300') seismic events, and (4) shallow (300'-1,500') seismic events. The above information in conjunction with information from deep penetration seismic data will provide data for assuring safety in platform location, drilling operations and pipeline emplacement, all necessary aspects of an effective OCS lease management program.

2. Exploratory Drilling

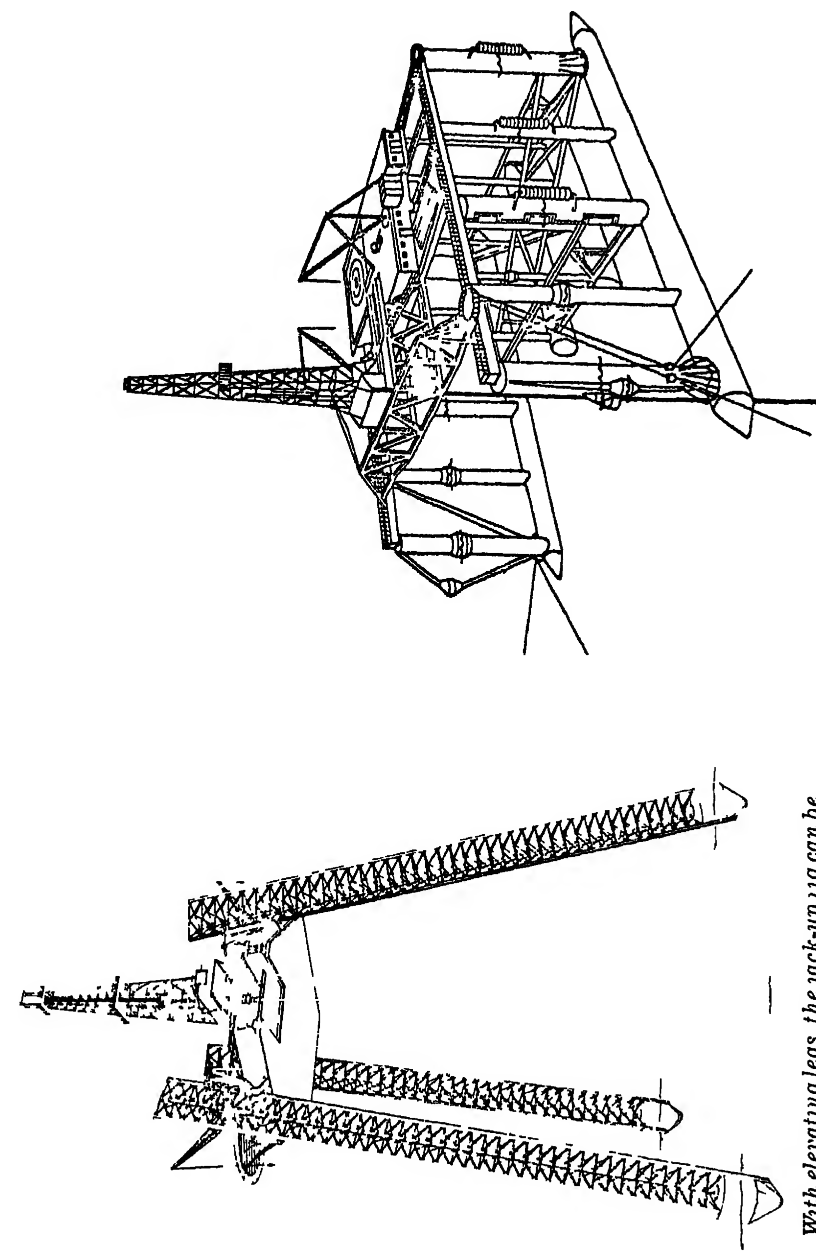
a. Drilling Phase

If this sale is held, exploratory drilling would commence within about thirty days from the date of the sale.

Most offshore exploratory drilling is accomplished with the use of mobile drilling rigs that can be moved from one location to another with relative ease. These mobile rigs include those that are bottom-supported while drilling and those floating rigs that are held in position over the site by anchors.

The bottom supported rigs (jack-ups) are floated from one location to another, and are most vulnerable to damage or loss while in transit. Shallow (less than 300 feet) water exploratory drilling is commonly carried out using a "jack-up" type drilling rig, while deeper waters require the use of semi-submersible rigs. The former is emplaced by being towed into position and having legs jacked downward to contact the bottom and lift the platform 30 to 50 feet above the water surface. The latter is transported in the same manner but is held in position by several anchors. These types of drilling rigs are shown in Fig. 2.

In drilling, two distinct, important pressures must be considered. One is the pore fluid pressure of the geologic formation penetrated



Once anchored in place, the semi-submersibles used to drill wildcat or exploratory wells in depths up to 1,000 feet and beyond.

With elevating legs, the jack-up rig can be floated to location and then raised or jacked up on the legs to appropriate height above water. This rig is normally limited to about 300-foot water depths

Figure 2.--Exploratory Drilling Rigs

(from "The Offshore Search for Oil and Gas," Exxon Background Series No. 2R, Nov., 1972, Public Affairs Department, Exxon Corporation).

and the other is the fracture pressure of the formation just below the last casing string and above the drill bit. These pressures are naturally occurring phenomena. A drilling plan calls for maintaining a sufficient hydrostatic gradient to prevent formation fluids from flowing into the wellbore. This is done by adjusting the density of the drilling fluid or "mud" that is continuously circulated through the drill string to provide pressure control, lubrication of the drill bit, and circulation of wellbore cuttings out of the hole (Fig. 3).

In spite of considerable research, it is still not always possible to predetermine, for wildcat wells, the formation fracture pressures and pore pressures that the wellbore will encounter. During drilling there are several means of determining the trend in pressure. They include measurements such as formation temperature (as reflected by the temperature of the returning mud), shale density and changes in the penetration rate of the drill bit.

If the hydrostatic gradient of the drilling fluid becomes less than formulation pressure, a "kick" of gas or other fluid may influx from the formation being drilled into the well. The influx displaces the drilling fluid, thereby causing an additional reduction in the hydrostatic head in the annular space between the drillpipe and the borehole (Fig. 4). If the volume of the influx is not excessive, and a

Example of Well Bore and Casing

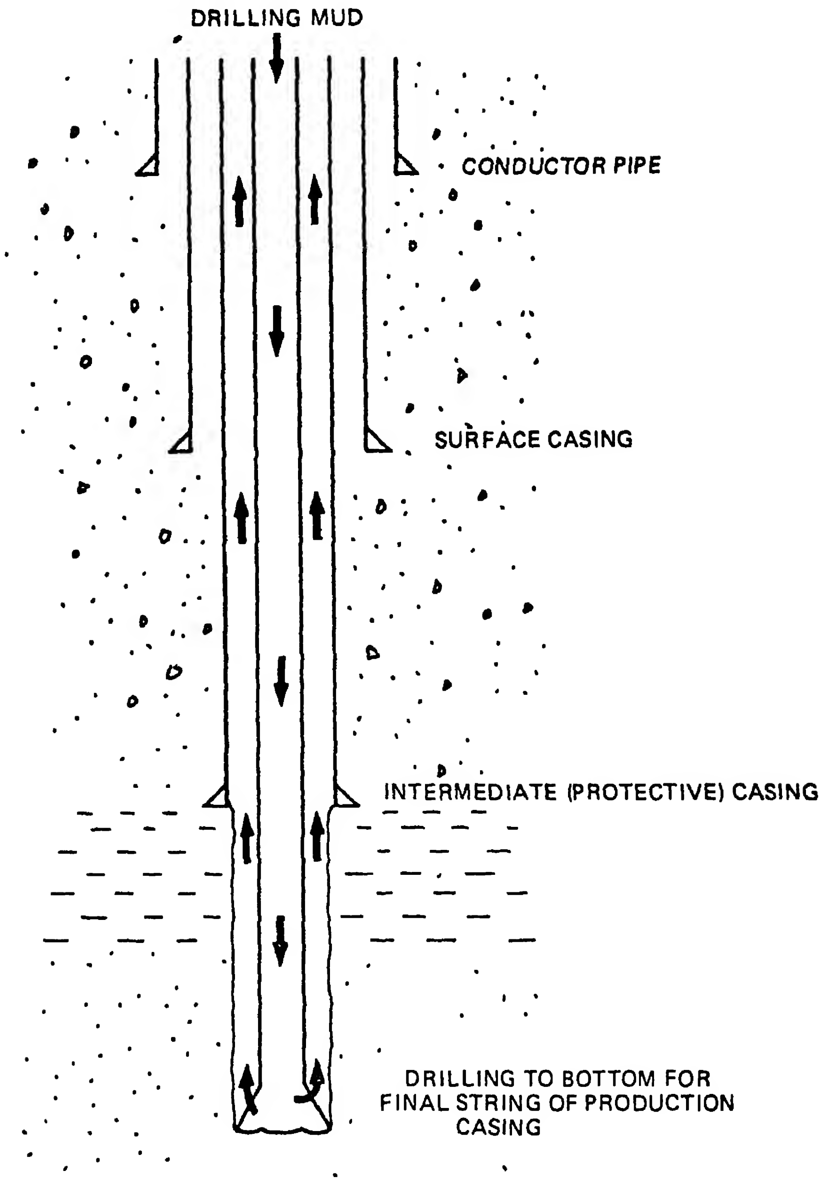


Figure 3.-- The drilling mud circulates down through the drill pipe and up the annulus. The relation between the mud pressure gradient and the formation fracture gradient is critical.

(Adapted from Panel on Operational Safety in Offshore Resource Development, "Outer Continental Shelf Resource Development Safety," Marine Board of National Academy of Engineering, Dec., 1972.)

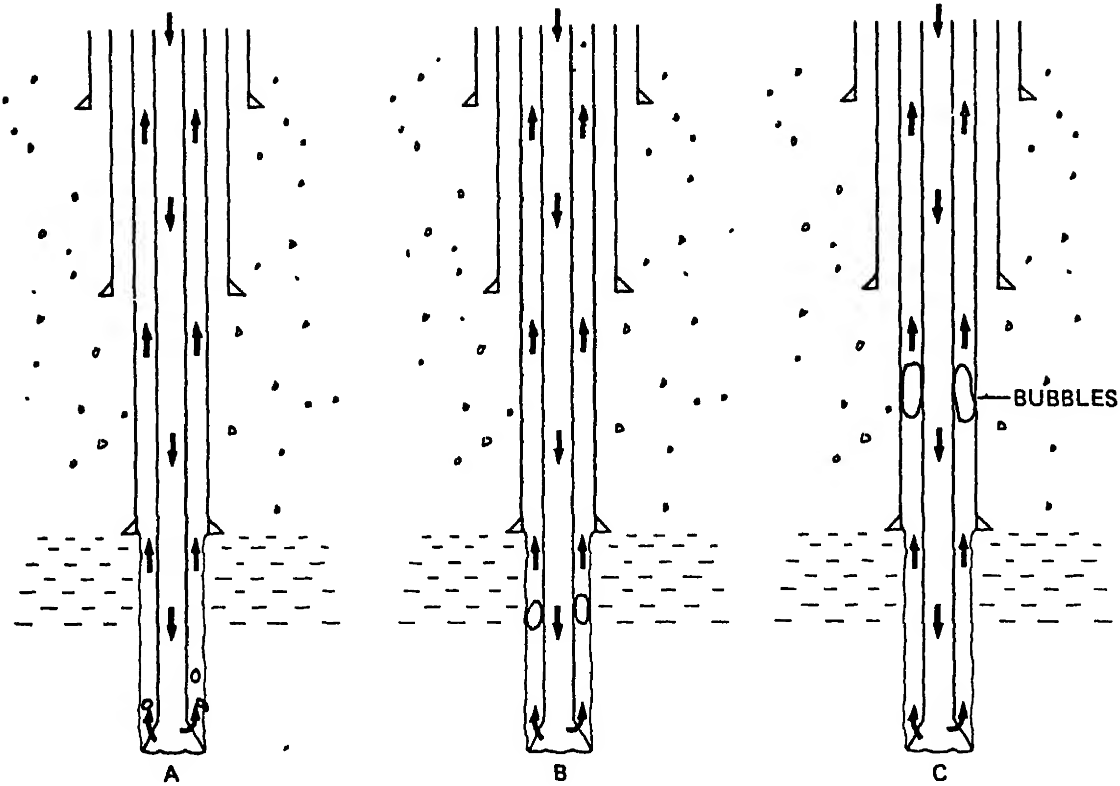


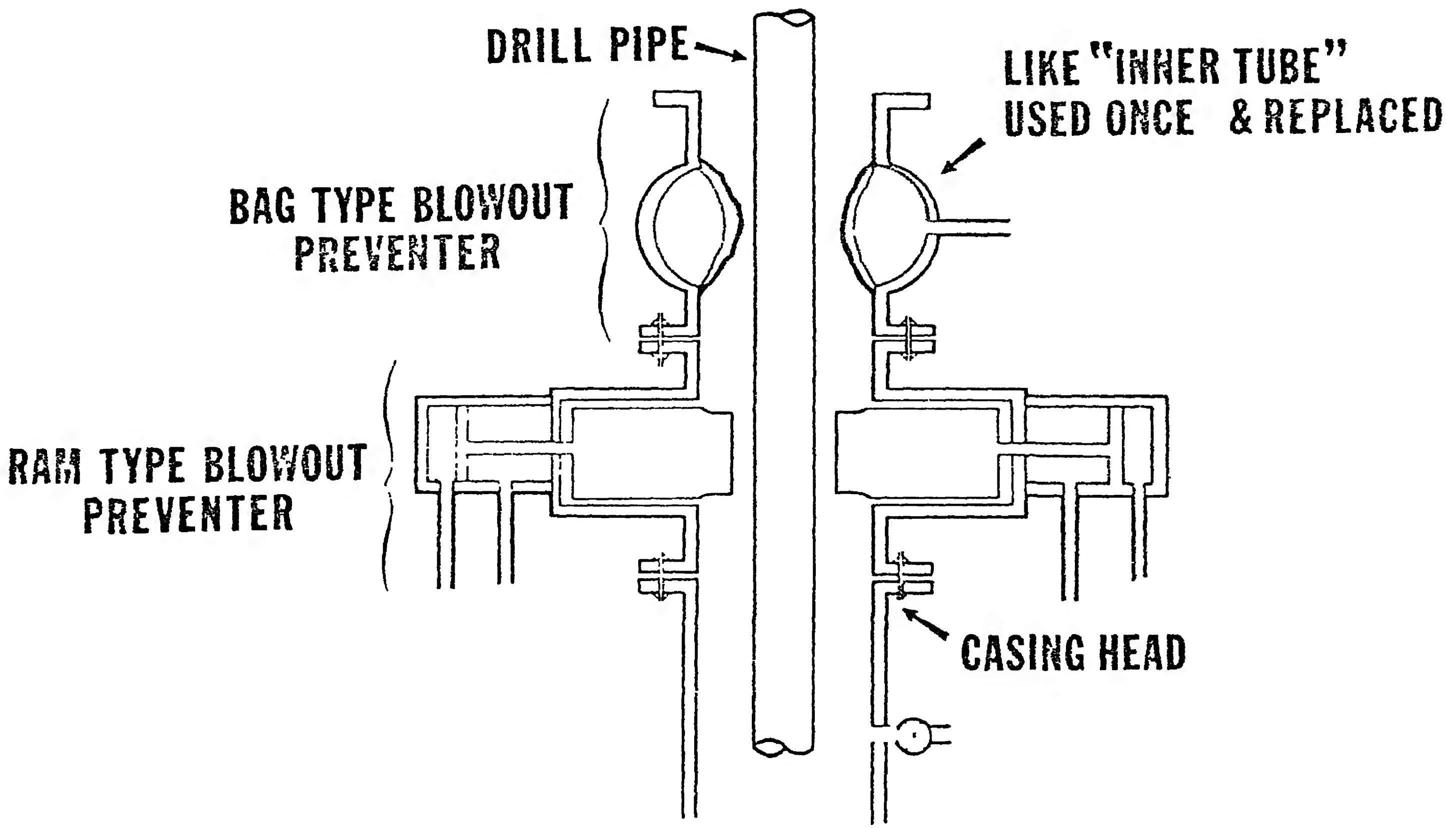
Figure 4.--A "kick" is a gas or liquid influx that reduces the hydrostatic head in the annulus. Here, the kick is a gas bubble (A). As it rises (B and C), it expands--causing a sudden increase in the upflow of the mud. When the bubble reaches the top, if it has not been allowed to expand, the bottom-hole pressure reaches a maximum -- the sum of mud pressure and the gas pressure. This pressure maximum, if excessive, can exceed the formation fracture pressure, and lead to an increased influx which may blowout at the surface or cause a formation-to-formation blowout.

(Adopted from Panel on Operational Safety in Offshore Resource Development, "Outer Continental Shelf Resource Development Safety", Marine Board of National Academy of Engineering, December, 1972).

surface indication of increased pit volume is observed, the unwanted influx of fluid or gas can be circulated out of the well by careful observation of well conditions and adherence to preplanned emergency procedures. From the record of a kick, the bottom-hole pressure can be determined accurately, and with this volume known, the mud weight can be increased to provide a sufficient hydrostatic head for the safe continuation of drilling.

An uncontrolled kick is called a "blowout". Blowouts seldom occur but usually can be controlled by implementation of preplanned emergency procedures and actuation of devices known as "blowout preventers" which are mounted on every offshore well during drilling. A simplified diagram of a blowout preventer is shown in Fig. 5. Actual blowout preventers used offshore contain at least two types of rams, one blind ram and one annular ram. Blowout preventers are essentially large valves that can close around the drill string or across an open hole and seal off the well at the surface. Blowouts can occur downhole when a low-pressure formation fractures, and fluids from a higher-pressure zone flow into the fractures formation. Such sub-bottom blowouts, like surface blowouts, require the careful use of preplanned emergency techniques to regain control. Blowout preventers and other well-control equipment must also be approved. This equipment is tested on a schedule set by prudent practice, but

Figure 5.-- BAG TYPE AND RAM TYPE BLOWOUT PREVENTERS



(From testimony of Bob G. Murphy on behalf of the Offshore Operators Committee at a public hearing in Houston, Texas, on February 22, 1973.)

not less often than regulations specify. In addition, when storms approach, riser pipe couplings permit disconnecting the drilling barge or vessel from the well, leaving it shut in with the blowout preventers safely closed.

Disposal and Use of Drill Cuttings and Fluids

Drilling fluids are seldom discharged off exploratory drilling rigs, but are usually cleaned and reused. Some muds, however, if free of oil, are discharged after their retention is no longer economical. Drill cuttings and well sand, after being separated from the drilling mud and cleaned of oil, are released and allowed to settle to the ocean floor.

Drilling muds usually used on the OCS down to the surface casing setting point consist of sea water and gel (bentonite clay). This is light weight mud with few, if any, chemicals. Below the surface casing, the mud system is generally changed to a sea water lignosulfonate system.

Some chemicals generally used are aluminum stearate for foaming control, bentonite for gelling mud, barite for weighting material, carboxymethylcellulose for fluid loss, lignosulfonate for a thinner and for fluid loss, bicarbonate of soda for cement contamination and caustic soda for pH control. Caustic soda is the only one of

these chemicals considered toxic in concentrated form. The muds that are used offshore have pH's in the range of 7.5 to 10. The caustic (sodium hydroxide) used to keep the pH high will, in the presence of sea water and within certain pH ranges, precipitate out as calcium hydroxide, magnesium hydroxide, and barium hydroxide, and will sink immediately to the bottom because of its specific gravity.

Mud systems below 12-13 ppg. would, under certain conditions, be uneconomical to haul to shore for re-sale or storage. The volumes to be disposed of vary from 250 to 2,000 barrels, depending on the rig's mud tank capacity and the size and depth of the hole. However, volumes of these essentially neutral muds are not dumped after the drilling of each well, especially in the case of platform drilling where it is retained for use in drilling other wells at that location.

Moreover, it may not be dumped at all because mud companies are very interested in obtaining this liquid mud for re-sale and bid for it when they have the opportunity and available mud boats to pick it up. Several companies have been organized specifically for the purpose of picking up, storing and re-selling drilling muds. Drillers also do not dump heavy, highly-treated mud systems that may be used for certain drilling conditions because such mud systems are expensive.

In any case, regardless of conditions, all oil base mud is shipped to shore and stored in tanks for future use.

To ensure that adequate provisions have been made for safety, the casing program and drilling fluid, or mud, program must be approved by regulatory agencies before a drilling permit is issued. Along with adequate casing, it is important that enough cement be injected between the casing and the borehole wall to seal off and isolate all sensitive geological formations such as hydrocarbon zones and fresh-water sands, and to separate abnormally pressured zones from those with normal pressures. A prime function of the drilling mud is to maintain hydrostatic pressure control in the well, and mud is tested frequently during drilling operations to ensure that it has sufficient density and meets other physical and chemical specifications.

b. Well Completion Phase

Should the initial test well be dry, it is plugged with cement. One objective is to confine formation fluids in their parent subsurface formations to prevent them from intermingling and to prevent flow to the surface. If a well is to be abandoned, the casing is cut-off at least 15 feet below the mud line, all obstructions are removed, and the bottom is dragged to be sure that no obstructions were overlooked. During plugging, well-control equip-

ments remains in use. In some cases, it may be necessary to drill several exploratory wells on the 5,000 acre block before the lease is totally condemned.

Formation fluids penetrated by wells are often brought to the surface in drill-stem tests to evaluate the possibility of oil and natural gas production. These fluids may be collected in tanks at the surface; drilling mud is separated from the produced fluid, and if the formation fluid is oil it may be stored for later disposition, or the oil and natural gas are flared in specialized, high volume burners.

If wells tests show that commercial quantities of natural gas or oil have been found, it may be necessary to do several additional confirmation tests before the company is satisfied that the reserves will support installation of a drilling-production platform.

It is also important to delineate precisely the extent of the petroleum reservoir because of the extreme expense of deeper water platforms and the economic necessity of drilling as many production wells as possible (sometimes over 30) from a single platform. Platform location in relation to hydrocarbon deposits must be extremely accurate to minimize the number of platforms installed.

If petroleum deposits prove to be commercial, one of two courses of action may be followed:

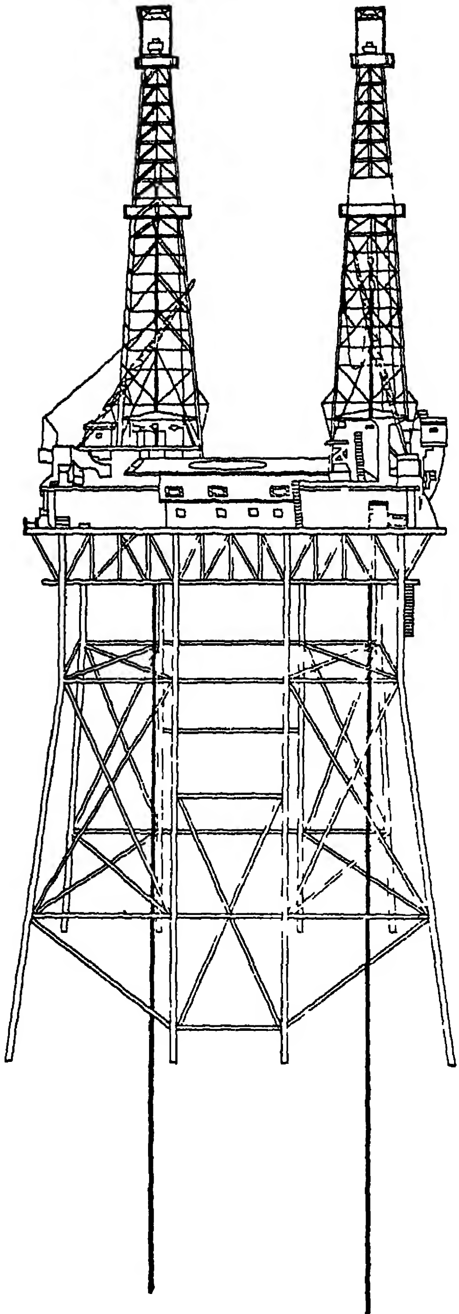
(i) The exploratory well may be deemed expendable and be permanently abandoned. Procedures followed would be the same as above.

(ii) The well may be deemed useful for future use as a production well and temporarily abandoned. In this case, a mechanical bridge plug is emplaced in the smallest string of casing and the well head capped and left for future entrance when production activity commences. This results in the temporary existence of an underwater "stub". The Coast Guard District Commander requires that such stubs be marked by a lighted buoy at the surface if located in 85 feet or less of water and by a buoy if in 85 to 200 feet of water.

3. Production and Workover

a. Platform Installation and Production Well Drilling

Offshore production operations are usually conducted on fixed, bottom-founded, water surface-piercing platforms (Fig. 6). The platform is generally fabricated in two pieces at a shore-based facility according to design specifications of the petroleum producers. The two component pieces, the supporting structure and the upper, horizontal platform, are then towed or barged to the installa-



Rigs mounted on fixed platforms, used for development drilling after an oil or gas discovery, permit drilling up to thirty wells from a single platform and location. After drilling, the rigs are removed, and the platform is used for production.

Figure 6.--Fixed Production Platform

(from "The Offshore Search for Oil and Gas," Exxon Background Series No. 2R, Nov., 1972, Public Affairs Dept., Exxon Corp.)

tion site. The structure is emplaced by controlled flooding and sinking of the lower end of the tubular legs. The horizontal platform is then lifted into place on top of the tower and welded to it. The drilling derrick rig, power plants, generators, living quarters, storage sheds and other components, constructed in modular form, are added to the platform, and production well drilling commences. The sequence of drilling operations for production wells is essentially the same as for exploratory wells.

Wells usually are produced through tubing placed inside the final or production string of casing. During tubing installation, the blowout preventers remain in use to ensure control of the well. A system of in-tubing safety valves, plus other casing and tubing valves at the surface or seafloor, is installed to control well flow. Actuation is usually at the producing platform. A wellhead, consisting of several redundant control valves, is installed at the platform cellar deck level and subsurface safety valves are installed at depths varying from a few hundred to several thousands feet in the tubing string.

Of major concern in the operation and control of every production platform are the downhole control devices. Production tubing is fitted with one or more safety valves that are installed and located at least 100 feet below the mud line or seafloor. In the past,

velocity choke valves designed to shut off production when the flow rate exceeds predetermined limits have been used. Such valves should close if surface equipment failure results in an excessive flow through the tubing. These chokes are particularly susceptible to failure from internal erosion in areas where sand is produced along with the oil and gas.

Certain types of fail-safe valves do not depend on the velocity of well fluids for actuation, but are held open by hydraulic or other fluid pressure applied from the surface. Release of this pressure by a control signal, or by an accident, causes them to close immediately. Their use will increase costs significantly, but the need for more reliable valves has been shown by recent incidents in the Gulf of Mexico and elsewhere. The increased degree of safety offered by use of the fail-safe valves justifies their installation.

b. Produced Formation Water

The waters associated with oil and gas pools which are frequently produced along with the oil and gas are called formation waters. The lower edge or boundary of most oil and gas pools is marked by an oil-water or gas-water contact. In some pools, water is produced with the oil in early stages of production, whereas in others, appreciable water never comes up with the oil.

Most formation waters produced in the Gulf of Mexico are brines, characterized by an abundance of chlorides, mostly as sodium chloride, and have concentrations of dissolved solids several times greater than that of modern sea water. The total amount of mineral matter commonly found dissolved in oil-field waters range from a few parts per million (ppm), nearly fresh water, to approximately 300,000 ppm, a heavy brine. One of the highest brine concentrations recorded was 624,798 ppm; or 64.3 percent, from a field in Michigan (Case, 1945, as cited by Levorsen, 1958). 1/

The following table shows the content of three representative brines: (1) high solids, (2) average solids, and (3) low solids. The average total dissolved solids of 76 samples from southern Louisiana and the Outer Continental Shelf was found to be 112,513 milligrams per liter (mg/l; same as ppm if solvent is water). The average of available samples from Federal offshore areas was found to be 141,473 mg/l with a high of 270,400 mg/l and low of 61,552 mg/l. Note that they commonly contain varying amounts of iron, calcium, magnesium, sodium, bicarbonates, sulphate, and chloride, with sodium and chloride being the most abundant irons.

Total waste water production from OCS operations offshore Louisiana is about 420,000 barrels per day; 240,000 barrels per day are transported to shore for treatment and release, and the remaining

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1/ Listed in section III. Bibliography.

Chemical Content of Representative Offshore Brines 1/

Component	High Solids		Average Solids		Low Solids	
	Mg/1	%	Mg/1	%	Mg/1	%
Iron	153	0.057	15	0.011	139	0.226
Calcium	17,000	6.287	4,675	3.294	772	1.254
Magnesium	2,090	0.773	1,030	0.726	152	0.247
Sodium	84,500	31.250	49,120	34.612	22,651	36.800
Bicarbonate	37	0.014	100	0.070	933	1.516
Sulphate	120	0.044	0		188	0.305
Chloride	166,500	61.575	86,975	61.287	36,717	59.652
Total Solids	270,400	100%	141,915	100%	61,552	100%

1/ From U.S. Geological Survey, Oil and Gas Supervisor, Gulf Coast Region, New Orleans, Louisiana.

180,000 barrels per day are treated and discharged near the platforms. No figures are available for offshore Texas.

In the draft environmental statement (DES 73-1, released January 18, 1973), it was erroneously estimated that a portion of the produced formation water would be treated to remove entrained oil and discharged off the platforms at sea, and the rest would be piped ashore, treated, and released from onshore facilities. At the OCS Public Hearing concerning this proposal (held February 21-22, 1973, in Houston, Texas) Mr. E, O. Bell, past president of the Offshore Operators Committee and speaking in behalf of the entire offshore petroleum industry, stated that none of the produced waste water resulting from this sale would be piped ashore. He explained further, that it would either be treated and released into the ocean or would be reinjected into subsurface formations. In nearly all cases, reinjection is utilized as a secondary recovery technique by pumping the waste water, under pressure, back into the lower reaches of the petroleum-producing zone and thus maintaining good reservoir pressure.

Waste water which is to be discharged into the ocean is first passed through a water-polishing facility that removes all but traces (less than 50 ppm) of entrained oil. However, the water is still void of dissolved oxygen and contains large quantities of dissolved minerals.

c. Solid Waste Disposal

All solid waste accumulating from daily drilling and production operations is collected in large containers constructed of heavy grating. To reduce the bulk before being transferred to shore, wastes are sometimes compacted in mechanical compactors but are generally incinerated in burn baskets suspended from the platform. Ashes are allowed to fall into the water. Non-combustible solids are then loaded into service boats for transfer to shore. Solid wastes, transferred to shore, are emptied into municipal or private sanitary landfills which are subject to the sanitary landfill laws of the State.

d. Workover Operations

Since petroleum production involves the handling of flammable fluids under pressure, the safety systems control is of utmost importance to preclude hazardous conditions. Nowhere is this hazard greater than during workover, or remedial operations on a well in order to improve its production rate or to replace faulty downhole equipment. Since workover operations are potentially hazardous, they must be planned carefully, both to keep wells from getting out of control and to prevent or minimize the release of oil to the environment. To reduce pollution, specially treated salt water that can be weighted with various materials is used for hydrostatic control when re-entering the wells in wire-line or swabbing operations.

To increase production, acid or other fluid and suspended particulate matter may be pumped through the well bore into producing formations. The spent acid returns up the well when production is resumed, and is handled as are other fluids from the well. Oil and water contaminated with the acid are disposed of ashore.

Sand produced along with the well fluids can cause well periodically to plug, or "sand up", and must be removed. Other procedures to increase productivity and oil recovery include the injection of high-pressure steam, water and/or gas. The water used for this purpose may be taken from the ocean or from formation water. Contaminated water may be reinjected into formations, taking suitable precautions to ensure that fresh water aquifers will not be contaminated by oil or salt water. Gas produced from the well may be reinjected for pressure maintenance where feasible or piped to shore for sale.

From the safety standpoint, completion and workover operations must be carefully conducted, and it is their critical nature that, in all likelihood, makes these operations safer than they otherwise might be. Operators of swabbing and wire-line units are well aware of the hazardous nature of their work and are extremely cautious. Despite the potential hazard, safety records during wire-line and swabbing unit work are excellent.

One problem peculiar to the safety of these operations is the possible interaction between workovers during drilling, and workovers during production on the same platform. In two major incidents this interaction may have been contributory. (One of the incidents, a 1 December 1970 fire on a platform in the Gulf of Mexico, occurred during wireline operations to clean out a well. During a period when the well was believed to be shut-in and left unattended, plastic, which had slipped into the valve, was released and the well blew out and ignited. Of the 22 completed wells on the platform 11 caught fire.)

4. Construction and Maintenance of Pipelines

After estimates of producible oil and gas have been made, based on exploration data, plans for pipeline construction are formulated. In connection with the present proposal, a canvass of industry representatives has revealed that at the most, three new major pipelines will be needed to transport reserves to shore. In addition, short spur lines would be required to connect individual platforms to main pipelines.

These pipeline requirement projections are based on the depleting nearshore production, anticipating excess capacity of existing trucklines to shore and the fact that economics of production from deep water, distant, offshore areas requires group efforts to bring oil and gas ashore.

Pipelines laid offshore are fabricated by welding sections together on a barge while simultaneously moving the barge forward and allowing the completed expanse of pipeline to sag downward and lay on the bottom. In nearshore areas, if space permits, pipelines are welded together on the beach and the completed string pulled out to sea by a workboat.

In water depths greater than 200 feet, nothing further is done with the pipeline except to use it in transporting produced oil or gas. On February 22, 1973, at the Public Hearing held in Houston concerning this proposed sale, Mr. E. O. Bell, testifying for the Offshore Operators Committee, was asked by the Hearing Panel if industry is equipped to bury pipelines beyond 200 feet. Mr. Bell replied as follows:

> We are not equipped at the present time. Both of the large people who are consultants in this business, the contractors who aré involving in laying pipe and burying it in the Gulf of Mexico, both of these companies are working on equipment that could bury pipeline beyond the 200 feet level. This improvement would not be ready for possibly one to two years.
>
> It involves a tremendous change when you go beyond the 200 foot depth. This is the practical limit at which a diver can work without going to mixed gases. It would require a different type of inspection to make sure that the pipeline was buried. It would require completely different equipment, mechanical equipment, located on the burying barge itself. Because it is in deeper water, they would have to go to larger air compressors, larger jet pumps, water pumps that jet

> the bottom deposits. They have to go to a higher pressure. Some of the figures, for example, on this, to go from 200 feet to 350 feet, the pump horsepower would have to be increased from 7,200 to 23,500.
>
> The volume of water would increase from 6,500 gallons per minute to around 18,000 gallons per minute. The pump pressure would go from 1,300 pounds to either 1,970 pounds or about 2,500 pounds, depending upon your compressor and pump arrangement. Your air volumes from your compressor to lift the cuttings so that the pipeline would settle into the trench would go from 3,600 cubic feet per minute to around 4,500, and that pressure on that would increase from 275 pounds to 500 pounds. At 200 feet we are at about the maximum limit that we can go with our present equipment. From here we have to go to completely newly designed equipment.

In depths under 200 feet, present OCS administrative procedures require burial of the pipeline. Burial is effected by jetting sediment away from underneath the pipe and allowing it to sink into the resulting trench. No attempt is made to fill the trench and cover the pipeline, because over a period of time, settling and reworking of sediment by underwater currents, buries the pipeline. In much of the continental shelf in the Gulf, even unburied pipelines eventually sink into the soft underlying sediment, and are thus buried, but this phenomenon may require months to years to take place.

As the pipeline construction approaches and transgresses the shoreline, it is buried deeply enough to avoid its being exposed by storm-associated beach erosion. From this point the pipeline construction will be extended toward a storage facility, gas processing facility,

interstate gas line, or a major existing pipeline system, in turn leading to a processing facility, refinery, or interstate gas line. Before the new pipeline reaches its inland terminus, it may cross beach, sand flats, saltmarsh, stream courses, and perhaps freshwater marshes. Where pipelines cross frim soil or sand, it is normally buried by entrenching and backfilling. In other areas the pipeline is buried by jetting-out around the pipeline. In the saturated coastal marshes, sections of the pipeline are usually floated through a narrow ditch, called a shove-ditch, welded together, sunken, and buried by backfill.

In the draft environmental statement concerning this proposal, it was erroneously suggested that where pipelines are laid across the marsh, it might be necessary to excavate a ditch large enough to accommodate a pipeline-laying barge. This would result in a large, permanent open canal. Mr. William P. Heineman of United Gas Pipe Line Company submitted exhibits and testimony at the Houston OCS Public Hearing describing soil conditions and pipeline burial techniques for the upper Texas coastal marshes. He stated "...the marshes west of the vicinity of Cameron, Louisiana, extending as far as Corpus Christi, Texas, are generally underlain by a firmer soil than are the marshes east of Cameron. It is our experience that pipelines can be laid in this firmer soil by laying techniques which do not require the use of

canal type ditches. We have also found that the soil is adequate for backfilling of the ditch, and does not require additional soil from other sources."

To prevent corrosion, most pipelines are carefully coated with such materials as epoxy compounds or thick asphaltic mastic. If extra weight is needed, or if mechanical damage seems likely during installation, these, in turn, are covered with a layer of dense concrete. The lines are protected from electrolysis by both impressed-current systems and by sacrificial anodes (zinc is commonly used).

Pipelines are also commonly equipped with a number of redundant systems to control flow and detect small leaks. On larger pipelines a control center from which all valves can be operated by remote control, and that has constant communication with other points on the line, is manned 24 hours a day. Line pressure and flow rate sensors linked to automatic shutdown devices cut off all flow in the event of a leak. Block valves and check valves can isolate a leaking section of a pipe quickly. In addition, the lines are inspected as appropriate by submersibles (small submarines), divers or other methods.

Although offshore pipelines are relatively inaccessible as compared to onshore pipelines, they nonetheless can be repaired by divers. Experimental dives have been made to 1,000 feet, but work at this depth

is difficult and expensive. Methods of using submersibles to latch on to a subsea line and repair it with mechanical arms and special tools are under study and nearing the point of practical demonstration.

As in the case of workover operations, the expense of the pipeline installations, coupled with the catastrophic implications for the local marine environment should a major break occur, have combined to dictate a highly conservative design, emplacement, and operating philosophy.

5. Terminations of Offshore Oil and Gas Operations

According to industry estimates, with proper placement of wells and sufficient pipeline capacity, a gas reservoir could be profitably drained in as little as ten years. In contrast, some oil reservoirs have been produced for over twenty years in offshore areas. When the reservoir has been depleted to a level where it cannot be profitably produced, operations are terminated. The production platform is removed and the wells are plugged with cement, the casing severed at least 15 feet below the mudline and all obstructions removed. All that remains is the pipeline system. Frequently, major trunklines can be used for future oil and gas production from adjacent areas, but smaller spur lines are abandoned in place.

G. Relationship of This Proposed Action to Existing and Prospective Offshore Oil and Gas Development in the Gulf of Mexico

This proposed action must be viewed as one part of a continuing activity that has been underway since the 1940's and that will continue indefinately, with or without this proposed lease sale, on into the future. Although primary emphasis concerning the description of the proposal and its potential environmental effects has been placed on this particular sale in isolation from all previous activities of the same nature, care will also be taken to put it into a perspective of an on-going offshore oil and gas development process. To date there have been 23 OCS oil and gas lease sales on submerged lands in Federal areas of the Gulf of Mexico. In addition, there have been numerous offshore lease sales for oil and gas development held by the respective state governments in areas of their areas of jurisdiction in the Gulf of Mexico. For example, the State of Louisiana since 1943 has held about 105 sales and since 1958 the State of Texas has held about 31 sales which included offshore tracts. The implication here is that there are no activities implicit in this proposed action, as described in the above sections, that have not been performed in the area under study in the past or that will not continue to be performed until all activity ceases on the existing leased offshore lands.

The relationship of this proposed sale to other offshore oil and gas development activities in the Gulf of Mexico indicates that additional

increments of transportation and storage facilities, platform and pipeline construction activities required if this sale proceeds, for example, will be added to a whole network of existing facilities and activities. Moreover, as production declines in existing areas, much of the equipment, transportation facilities, pipelines, platforms, etc., not to mention the personnel and technological expertise presently available, can be used for new areas of activity. As existing areas of production decline the pipelines in place for that system can be used for new production areas, adjacent, or further from shore, reducing the quantity of pipelines necessary to transport production from new areas to shore. This latter event has already been exercised in some areas of the Gulf of Mexico. Likewise a reduction in quantity of onshore facilities such as treatment plants, refineries, storage facilities, etc. is made possible by utilizing existing facilities, equipment and technology. Nevertheless, in this proposed sale some new pipelines, platforms and a very limited expansion of some onshore facilities will be required although the quantities involved will be less then they would be without utilization wherever possible of existing facilities.

II. DESCRIPTION OF THE ENVIRONMENT

A. Geologic Framework: Geologic History and Physiography 1/

1. Origin of the Gulf of Mexico

The origin of the Gulf of Mexico has been proposed to be related to the extensive regional subsidence of more than 10,000 feet during Cretaceous time, and its isolation came about by the continuous carbonate growth of the Florida and Yucatan platforms (Wilhelm and Ewing, 1972). Minimum rates of sediment deposition, compared to the rate of growth, led to consistent deepening of the gulf, which, accordingly, must be underlain by a thin Cretaceous section.

The Gulf of Mexico has been reduced to its present size by the invasion from the north and northwest of the huge Cenozoic mass of deposits--referred to as the Gulf Coast geosyncline 2/. However, later deposits from the Mississippi and other rivers were laid down on the continental shelves and a minimum of terrigenous material has been reaching the abyssal gulf by bottom flow known as turbidity currents. At the present time, a major part of the Mississippi River sediment goes directly onto the continental slope due to the prograding of the delta to near the slope edge. Wilhelm and Ewing (1972) consider the abyssal gulf to

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1/ A geologic time chart is affixed to this statement as attachment C.

2/ Geosyncline: A very large, trough like depression in the earth's surface; opposed to geanticline.

be a hemipelagic 1/ abyssal environment because of its proximity to land. They note that cores from its floor consist principally of lutites and calcilutites interbedded by thin layers and streaks of salt and fine sand. The Mississippi River has been the principal source of this turbidite material.

Thus, the modern Gulf of Mexico is a large Mediterranean-type sea which extends approximately 1,000 miles east-west and 800 miles north-south and occupies a sedimentary basin in which there has been deposition of terrigenous clastics 2/, carbonates, and evaporites since early Mesozoic times.

The northwestern Gulf coast is an alluvial or deltaic coast, characterized as being quite distant from the nearest mountains, and with runoff and sediment load from the lands having been large and long continued.

The coast of Louisiana and Texas receives the drainage of some ten major rivers. Three major recent deltas now reach the Gulf: the Mississippi-Red, Brazos-Colorado, and Rio Grande deltas. Interior plains are succeeded by broad coastal plains and continental shelves (Price, 1954). On such a coast, after sufficiently long still-stand 3/,

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1/ Hemipelagic: Sharing neritic and pelagic qualities. (American Geological Institute. "Glossary of Geology and Related Sciences." 2nd Ed. Washington, D. C. (1960).) I.e., refers to the semi-enclosed basin and broad expanses of continental shelf, in contrast to the great oceans.

2/ Clastics: Interbedded sand, silt, shale.

3/ Still-stand: No change in mean sea level.

shelf bottoms are smooth except toward their outer margins: reefs of biological origin are inconspicuous, few or absent, and shorelines are smooth or irregularly deltaic. Sandy sediments extend from the shoreline out to about 30 to 60 feet of water depth, followed by silt or sand and mud, with mud further out to the edge of the continental shelf. Mud or silt may extend from deeper waters to the mouth of a deltaic river that drains a large basin. The chief exceptions to the outward banding or zonation of sediments are coarse sediments of local organic or chemical origin or sediments on mounds overlying intrusive salt domes.

2. The Continental Shelf

The continental shelf is a gently sloping submarine plain of varying width forming part of the border of the continent out to a water depth of approximately 600 feet, at which point the continental slope begins. The continental slope has a steeper gradient, extending from the continental shelf edge to oceanic depths. The Texas-Louisiana shelf between the Mississippi delta and the Rio Grande delta ranges in width from about 70 miles on the west to 140 miles off the Texas-Louisiana border.

The numerous hills rising above the sea floor near the outer edge of the northwestern Gulf continental shelf materially influence the local sediments (Lynch, 1954). The dominant sediment on the

continental shelf west of the Mississippi Delta is mud and sand. In isolated areas near shore, sand predominates to form a sand beach and shore zone. The common heavy minerals of these sediments are amphiboles, epidote, dolomite, pyroxene, ilmenite, and biotite. Near the outer edge of the shelf and on the continental slope there are many topographic features of considerable relief, most being less than 300 feet above the surrounding sea floor, with a few above 600 feet. Numerous natural oil seeps have also been observed in this approximate area (see Fig. 7 for oil seeps and major sediemnt types in the Gulf of Mexico).

Stratigraphic studies show that the major sedimentary units in the northern part of the Gulf of Mexico geosyncline are arranged in belts parallel to the northern shoreline of the Gulf of Mexico. These sedimentary units have the general shape of flattened ellipses, with the thicker part of each sedimentary lens being the locus of deposition (depocenters) for a particular depositional epoch.

The Tertiary sediments of the central and western Gulf Coast are composed almost entirely of terrigenous clastics, and are characterized by intertonguing marine and non-marine strata. Some

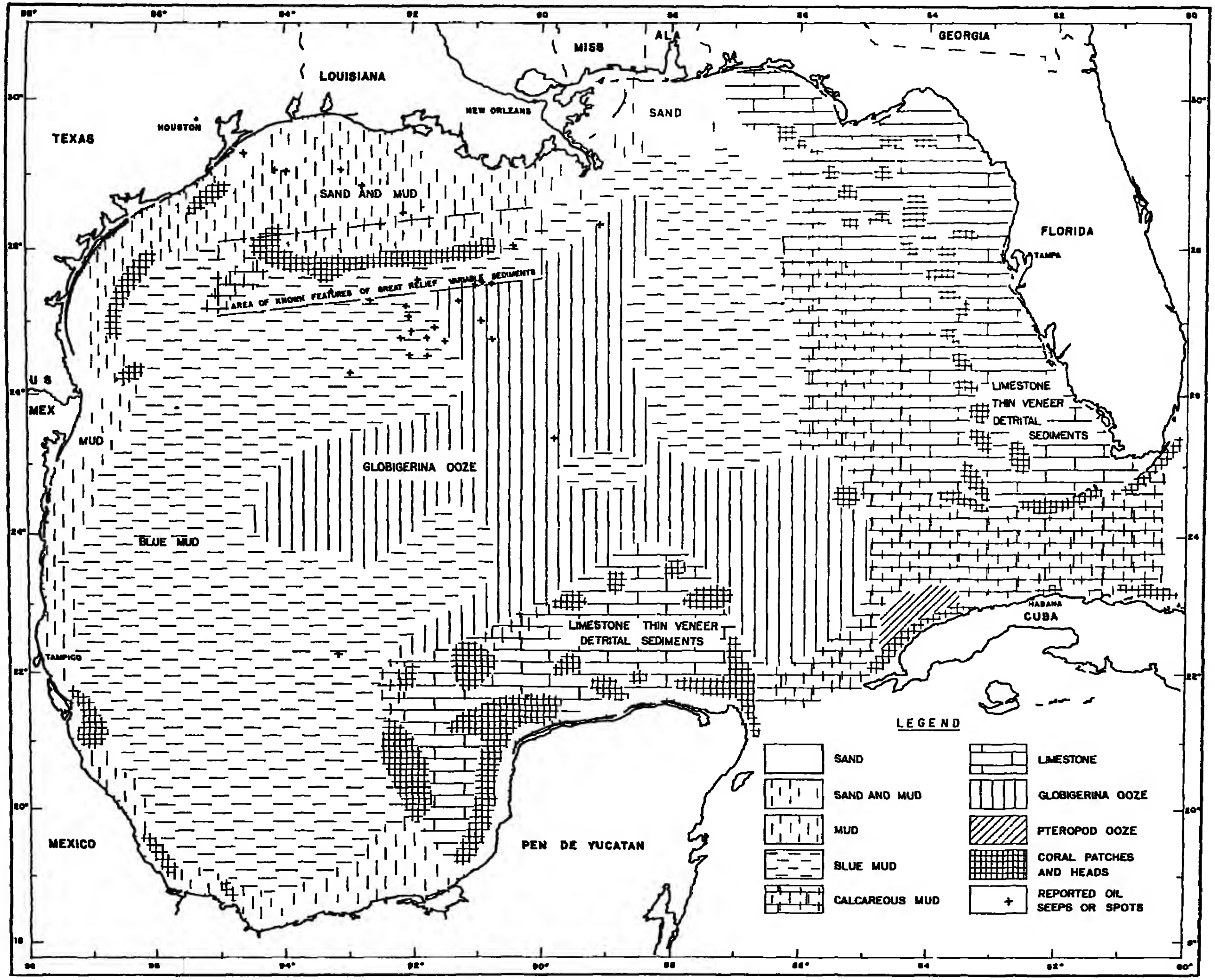

FIGURE 7 —Sedimentary provinces of the Gulf of Mexico Data compiled from many sources (From Lynch, 1954).

of the marine formations extend to the outcrop, but the shorelines of most of the formations are now deeply buried and the outcrop equivalents of these subsurface marine formations are mostly of continental origin.

At the end of Oligocene time, the depocenters for continental-derived sediments shifted eastward, and the Mississippi River system brought to this rapidly subsiding area great quantities of sand, silt, and clay. Much of these sediments were deposited in deltas and considerable amounts of clay and silt were carried by longshore currents to the inner-deltaic offshore area further west.

Most of the Texas coast and adjacent Continental Shelf area was coastal inner-deltaic, where no major streams (as compared with the Mississippi River) discharged; subsidence was less than in the area farther east; there were fewer fluctuations of the shoreline; and there was a relatively narrow belt of transitional enviromnents. Small rivers (Rio Grande, Nueces, Colorado, Brazos, Trinity, and Sabine) did transport a considerable amount of sediments to these parts of the Gulf Coast, but they did not construct deltas of the magnitude of the Mississippi delta. The sands that reached the sea were distributed laterally by longshore

currents and formed various islands by wave actions. The finer sediments were deposited in lagoons, bays, coastal marshes, and in the neritic zone.

The Colorado-Brazos River system did build several large deltas during Lower Miocene time when the area north of the Balcones fault zone (Fig. 8) was uplifted and became an important source for sediments.

The marine portion of the Rio Grande Embayment was undergoing rapid subsidence and sedimentation throughout Miocene time, and the Rio Grande River built several deltas in lower Texas and northeastern Mexico. These deltas were much smaller than those constructed by the Mississippi River, and they prograded onto a narrower and steeper Continental Shelf. This resulted in more delta abandonments, but the seaward and landward shift during regressions and transgression was not nearly so great as in the Mississippi deltaic province.

Pliocene time was a period of uplift and erosion and the sediments that accumulated in the Gulf of Mexico or that were deposited in the coastal environment are, generally, seaward of the present shoreline.

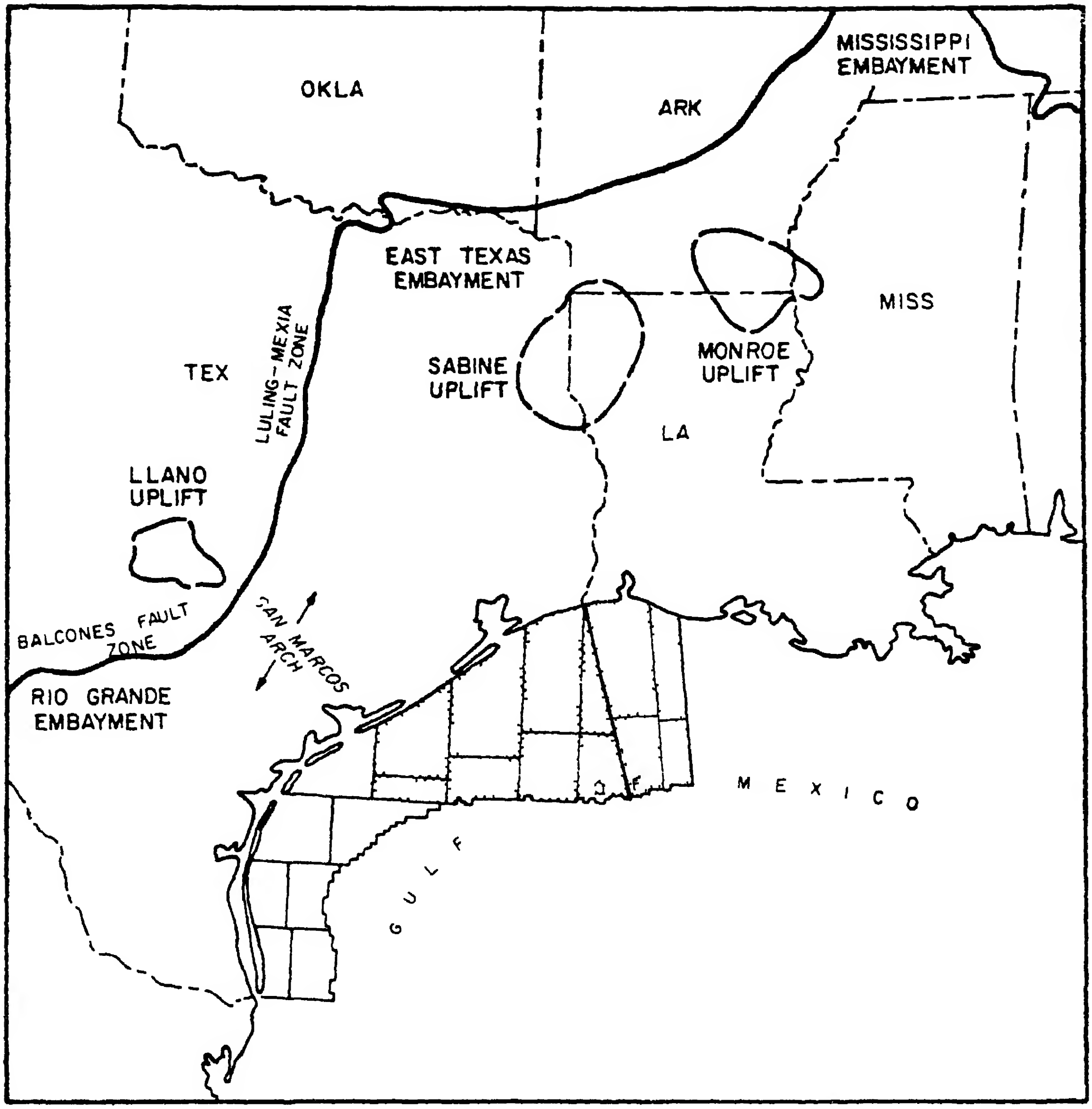

FIG. 8

MAP SHOWING RELATIONSHIP OF SALE AREA TO MAJOR TECTONIC FEATURES

SALE AREA

The prospective horizons under the proposed sale tracts are of Miocene, Pliocene, and Pleistocene ages. Figure 9 shows the major producing trends in the outer continental shelf. The trends are named according to the geologic age of the major hydrocarbon-producing sediments. Figure 10 is a generalized cross section through the sale area. The oldest sediments shown are of Oligocene age and are over 26 million years old. Sedimentation has continued with only minor interruptions to the present time.

Conditions necessary for oil and gas generation and entrapment are reasonably well understood. Generally, sands deposited within and on the fringes of a deltaic environment are favorable, especially the subaqueous portion deposited in ancient, nearshore, shallow marine environments. Very porous thick sands associated with continental environments are generally less favorable. Sands transported by marine shales are also productive in many areas. Local uplifts and faulting serve to localize and concentrate the hydrocarbons into commercial deposits.

Two distinct provinces are indicated to exist in the Texas Pliocene trend. One province occurs in the Texas offshore area south of the San Marcos Arch and is outside of the sale area. Structurally, the province is characterized by down-to-south faulting and extremely

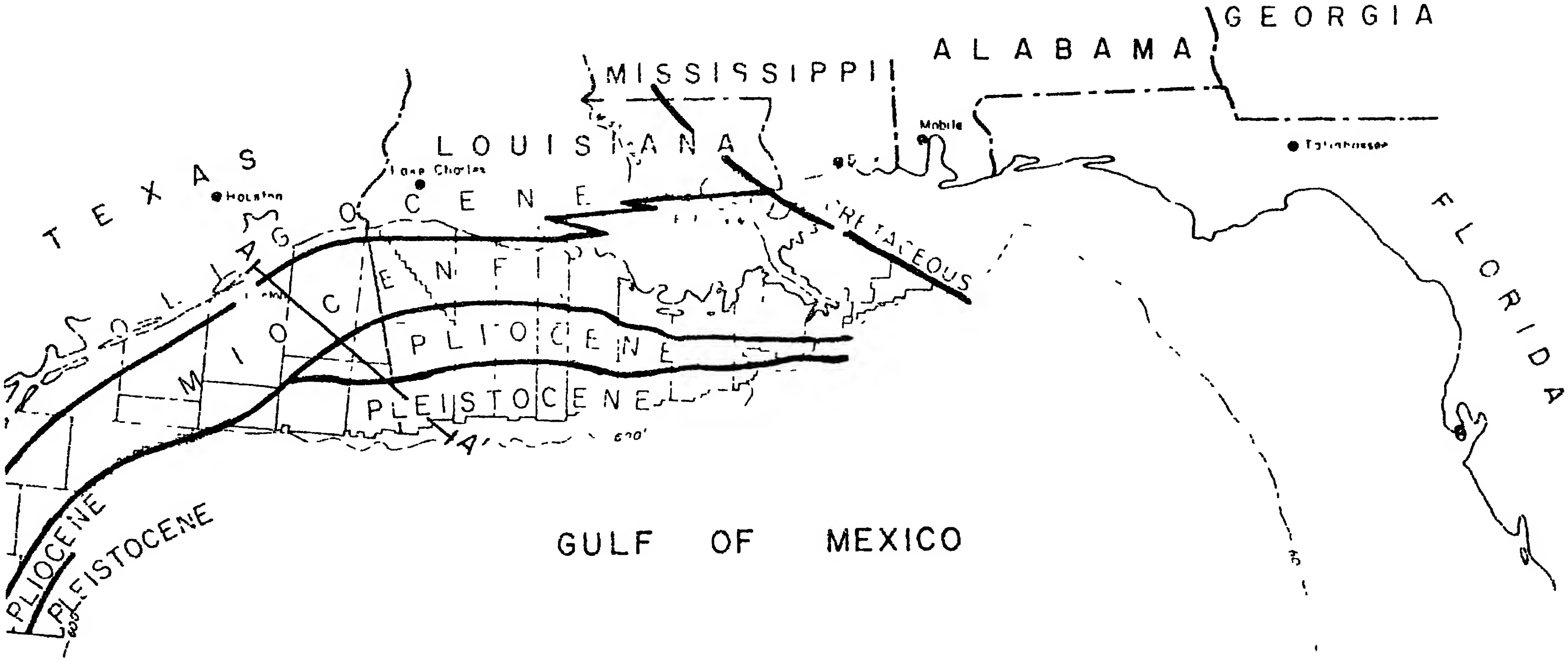

Fig 9 —Generalized outline showing ages of major producing trends, Federal OCS

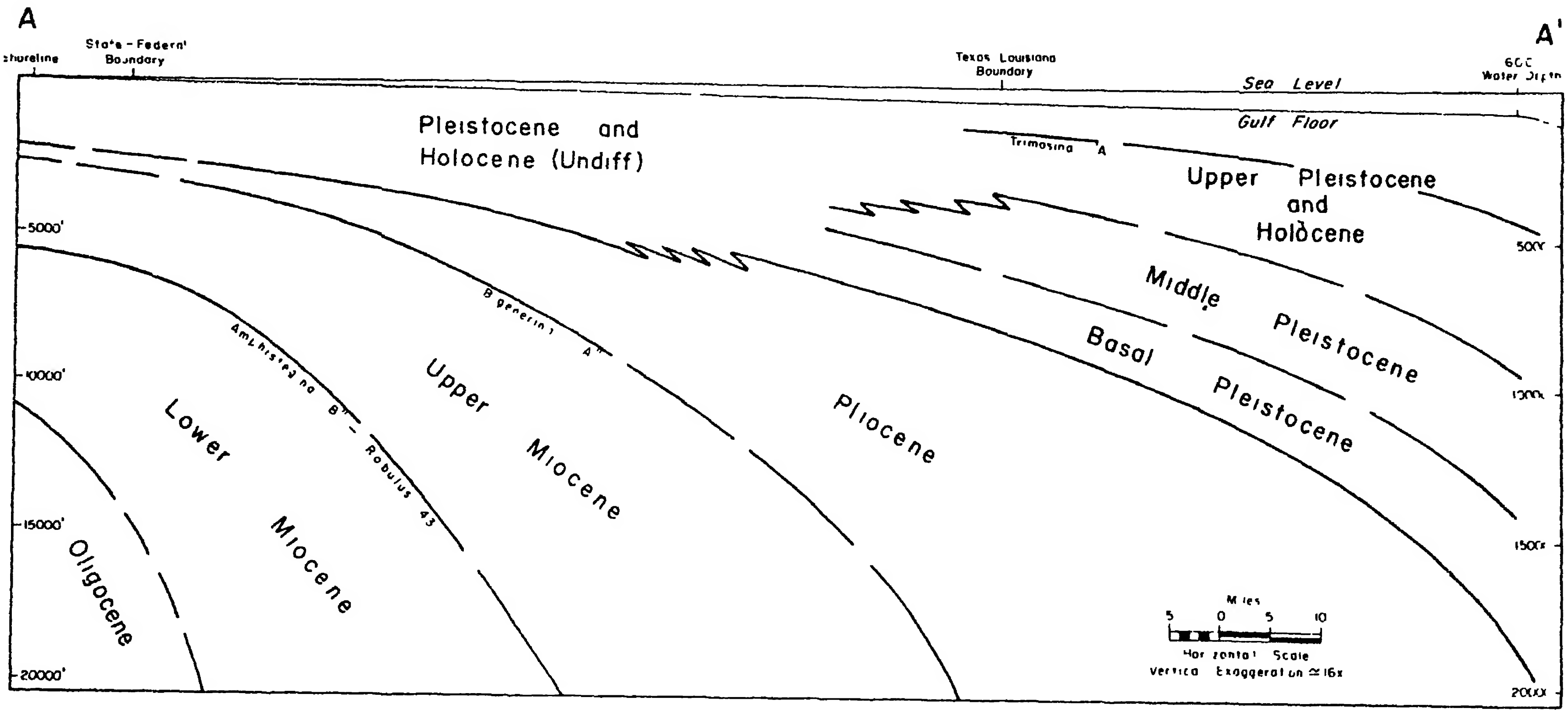

Fig 10— Generalized cross section through sale area, showing relationship between the various ages of sediments and depths of burial Line of section shown on Fig 3.

thick sediments and very little shallow salt doming, except near the outer margin of the continental shelf. Sediments are expected to contain considerable amounts of sand derived from the Rio Grande River and associated rivers to the north.

The other Pliocene province occurs in the eastern portion of the Texas offshore area and continues into the East Cameron and West Cameron areas of offshore Louisiana. This province is dominated by salt domes and deep-seated diapirs.

Two Pleistocene provinces are indicated in the offshore Texas region. The first province occurs in offshore southwest Texas, and generally is made up of the Pleistocene offshore delta of the Rio Grande River. The Rio Grande built a subaqueous delta which prograded across the continental shelf and continental slope. The Pleistocene sediments are typified by a fairly sizable quantity of sand deposited under dominantly marine conditions, with interbedded deposits of continental sand material. Salt intrusions are expected toward the edge of the continental shelf to the northeast. Secondary traps are expected to be formed by normal down-to-east faulting of the thick sedimentary rock sequences. This province is outside of the proposed sale area.

The second Pleistocene province is very pertinent to the proposed sale tracts and occurs from the eastern boundary of the Galveston Area eastward into the Ship Shoal area of Louisiana. This province has a thick sequence of Pleistocene sediments with favorable stratigraphic conditions for both the generation and entrapement of hydrocarbons in porous rock and, structually, is characterized by salt domes and deeper seated shale domes. The trend area, to the east (in West Cameron), is presently being developed as a gas producing province. Several fairly large gas fields have been found, some with associated condensate and oil reservoirs. The potential of this province for discovery of new reservoirs is generally regarded as being very good.

Paleontological studies of the proposed sale area indicate that four biostratigraphic horizons have a potential for hydrocarbon occurrences:

1. Trimosina "A" - Pleistocene
2. Angulogerina "B" - Pleistocene
3. Lenticulina "1" - Pleistocene
4. Valvulineria "H" - Pliocene

These conclusions are based upon a few scattered well bores and extrapolations from well control in adjacent offshore Louisiana.

Regionally, the above biostratigraphic units become thicker and get deeper toward the outer edge of the continental shelf. The Pleistocene thickness in the deep water tracts should be approximately 12,000 feet. The Pliocene sediments follow a similar trend toward the outer edge of the continental shelf.

The occurrences of hydrocarbons are directly related to the depositional environments of the sediments. The depositional environments of the sediments are assigned different paleoecological zone numbers and are ranked 1 through 6, with Zone No. 1 being nearest to shore and the ascending zone numbers indicating the zones farther from shore and in progressively deeper water until Zone 6 is reached, which is found in the Abyssal Plain in waters deeper than 6,000 feet.

In the Gulf Coast Region, most of the hydrocarbons occur from paleo-ecological Zone 4, and to a lesser degree, from Zones 3 and 5. The Pliocene and Pleistocene sediments for the proposed sale area have been deposited in paleoecological Zones 2, 3, 4, and 5.

Several nearshore tracts are located on an established productive (predominantly gas) Miocene trend, with the expected thickness of the Miocene sediments being about 7,000 feet.

The Flower Garden Banks, located approximately 120 miles south-southwest of Galveston, Texas, are the most prominent of a series of topographic highs in the Northwest Gulf of Mexico, and have been noted and studied for years. These features are related to salt uplift and biohermal reef development.

Seismic reconnaissance maps indicate that approximately 77% of the proposed sale tracts are located on salt piercement-type structures, and approximately 21% on deep-seated shale or salt domes. About 2% of the proposed sale tracts are located on features associated with extensive faulting. All of the structural features examined are considered favorable for the migration and entrapment of hydrocarbons.

3. Coastal Louisiana

West of the Mississippi delta regions, coastal Louisiana is predominantly salt marsh. Elevations range from 0 to about 3 ft. above mean sea level. The marshes consist of low tracts of periodically inundated land, supporting grasses, reeds and rushes. The most notable biological feature is the abundant plant life, creating ideal conditions for sediment and organic plant material entrapment.

The Atchafalaya River system is the main distributary of the Mississippi River above Head of Passes, and might have captured the entire Mississippi River discharge earlier in this century had it not been for the construction of controlling dams and levees. By 1950 the Atchafalaya was receiving in excess of 30 percent of the total Mississippi flood waters. Coarser detritus, sands, and silts are carried into Atchafalaya Bay and further westward by longshore

currents. Some of this material forms broad mud flats seaward. Once beyond the bay, fine muds are carried along the coast by westward currents, resulting in cheniers behind a zone of newly developing mud flat marsh. These cheniers, or stranded beach ridges, are a characteristic feature of southwestern Louisiana coastal marshlands. The chenier plain, also referred to as marginal deltaic plain, covers approximately 1,200 square miles and extends westward from Vermillion Bay to Sabine Pass. Another feature of the west central Louisiana coast is the intrusion of masses (domes) of rock salt to within 100 feet of the surface. This intrusion has brought about the formation of the "Five Islands" (Avery, Jefferson, Weeks, Cote Blanche, and Bell), which are hills overlying the salt domes and rising some 40 to 130 feet above the surrounding marsh. These formations are found along a line bearing S 49° E and run from Lake Piegneur to East Bay near the mouth of the lower Atchafalaya River. These salt domes are capped by Pleistocene and older material.

4. Coastal Texas

a. Geologic History

During one or more of the last Pleistocene interglacial periods, while glaciation had again diminished

and sea level was about at the present level, large rivers transported vast amounts of suspended mud and bottom-load sand from remote areas of Texas to deltas along broad embayments in the ancient Gulf shoreline (Fisher et. al., 1972). Late Pleistocene meandering streams, in the vicinity of the coast, became relatively straight to slightly sinuos delta distributary streams that extended across broad low deltaic plains. Sand and mud deposited at the mouth slowly extended the delta lobe into broad embayments, building land at the expense of the ancient Gulf embayment. Gulf currents and shifting distributary courses served to redistribute some sediment over wide expanses but most sediment compacted and subsided beneath the advancing delta.

Fisher et. al. (1972) explain that as pleistocene deltas built seaward, they encountered long low, narrow barrier islands or strand plain sand bodies, much like the present barrier islands. The ancient barrier-strand plain deposits are composed of shoreface sand and silt and thin, well-sorted beach sands. From Smith Point northeastward toward the Port-Arthur area, large expanses of the ancient barrier-strand plain deposits are still exposed.

Continuing with the account given by Fisher et. al. (1972), with the last rise in sea level at the end of the last glacial

episode, unfilled parts of the Trinity and San Jacinto Valleys were drowned by marine waters, producing estuaries known as Trinity and Galveston Bays. East Bay and West Bay developed as elongate lagoons, behind Bolivar Peninsula, which grew southwestward by spit deposition and shoreface deposition from eroded deltaic headlands near High Island, and behind Galveston and Follets Islands, which developed as coalescing, exposed offshore bars that grew seaward by shoreface deposition.

Sabine Lake is presumed to have developed from an ancient open bay into which the Sabine and Neches Rivers dumped their sediment loads. Much deposition took place within the bay, but because of the relatively high rate of stream discharge, large amounts of clastic materials were carried out of the bay and deposited and reworked into a mud flat-chenier plain, leaving only Sabine Pass as a channel of communication between Sabine Lake and the Gulf.

b. Geomorphology 1/

The major recent fluvial systems of the upper Texas coast include the Neches-Sabine Rivers-Sabine Lake and Pass, and the Trinity, San Jacinto, and Brazos Rivers. The Sabine, Neches, Trinity, and San Jacinto Rivers have developed

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1/ From Fisher *et. al.* (1972).

in entrenched or incised valleys; the Brazos does not occur within an entrenched valley but flows at approximately the same elevation as the surrounding coastal uplands.

Only two river systems are currently contributing to shoreline accretion and deposition along the upper Texas coast. The Brazos River, near Freeport, which is actively building a delta and the Sabine-Neches system, which is involved in the development of the chenier-mud flat system as described above.

Fluvial-deltaic environments include the following: meander belt sands, flood basin muds, undifferentiated fluvial sands and muds, abandoned channels, point bars, levee deposit, headward-eroding streams, lakes such as Lake Charlotte, Cotton Lake, and Lake Anahuac, vegetated and unvegetated levees, fresh, brackish, and salt marshes, abandoned berms and beach-ridges, bay-margin sands and mud.

A major and very natural system along the upper Texas coast is the barrier-strand plain-chenier system. This system has its origin at the interface of the land and ocean, as described in the discussion of coastal Louisiana. Extending landward from the shoreline, the main components of the barrier-strand plain system are (1) barren beaches consisting of sand and shell; (2)

beachridge and barrier flat, consisting of grass-covered sand ridges and swales (commonly floored with fresh-to-brackish-water marshes); (3) wind-tidal flats, predominantly bare sand occurring between the backside of the barriers; and (4) salt marsh, with sparse to dense growth of salt-tolerant plants and inundated almost daily by astronomical tides. In places, sand-tidal flats and back-barrier beaches may develop on the bay side of the barrier. Other components of the barrier system are washover channels and fans and others comprising the tidal inlet, tidal delta, and accretionary spits.

The lower parts of the coastal areas and river valleys, generally at elevations less than 5 feet above sea level, support an extensive wetland-marsh system along the upper Texas coast. These areas are associated with and developed upon a variety of land forms including (1) flood-tidal deltas, (2) back sides of barrier islands and peninsulas, (3) mainland shoreline, (4) bayhead deltas, (5) abandoned tidal creeks and washover channels, (6) flood plains of major fluvial systems, (7) abandoned coarses and cut-offs of present and inactive stream systems, and (8) mud flat-chenier plains. Components of the wetland-marsh system include (1) closed brackish marsh, (2) salt-water marsh, (3) fresh-to-brackish-water marsh, coastal lakes and ponds, (5) fresh-water marsh, (6) tidal mud flats, and (7) swamp (chiefly wooded vegetation).

B. The Climate of Coastal Texas and Louisiana, and Adjacent Gulf Waters 1/

1. General Climatology and Seasonal Weather Patterns

The following air masses either influence or control the weather in the northwestern Gulf of Mexico.

Tropical Maritime (Tm): This air mass enters South Texas from the south and southeast, as a result of the circulation around the Azores-Bermuda high pressure cell. During the period March through October, Tm air predominates at low levels across all of South Texas and the adjacent Gulf. From May through September, Tm air dominates the area almost completely. Overrunning of polar air by tropical maritime in the winter season is a common occurrence. This situation almost always results in stratus clouds with accompanying low ceilings and visibilities.

Polar Continental (Pc): This air mass rarely pushes into the northwestern gulf before October or after April, but is frequent during the winter and early spring months. It undergoes rapid modification in the area. When this air mass pushes out over the Gulf of Mexico, the return flow of modified Pc and Tm air almost always produces low stratus clouds over adjacent land areas.

1/ Information sources: Leipper (1954a), Louisiana Wildlife and Fisheries Commission (1971), and Orton (1964).

Polar Maritime (Pm): This air mass is most frequent during the fall and during spring. It is rapidly modified, and the return flow of Pm and Tm air from the Gulf also results in extensive stratus formation over adjacent land areas. Overrunning by Tm air is not as frequent as with the Pc air mass. The small migratory highs of either Pm or Pc air that move down from the continental land mass result in clear skies, no fog, and little or no turbulence.

a. Winter

The northwestern Gulf of Mexico is a winter spawning ground for cyclones, which form in association with quasi-stationary cold fronts, especially Pc types. Low pressure systems usually develop on the front near the Texas or Mexican coast in association, with a trough moving eastward from southern Arizona. These waves usually travel eastward rapidly, once movement begins, but in the development stage, low ceilings and continuous rain persist for 24 hours or longer. The principal track of the associated low centers parallels the Gulf Coast before passing across northern Florida or southern Georgia into the Atlantic. Major development of the low center into a dangerous extratropical storm ordinarily does not occur until the system reaches the Atlantic.

Fair weather in the northwestern Gulf is confined largely to the closed centers of rapidly moving (eastward or southeastward) high pressure cells that pass directly over the area. This limits the duration of fair weather to about 36 to 48 hours during the winter season.

b. Spring

During March, Pc fronts usually become quasi-stationary farther north than in February, so that the principal track of low centers lies just inland along the northern Gulf Coast. However, quasi-stationary fronts continue to frequent the northern Gulf region and cause persistent periods of low ceilings and rain lasting 24 hours or longer. Fair weather is still largely associated with the closed centers of migratory anti-cyclones.

Cold fronts enter the Gulf much less frequently in April and almost never in May, so that frontal weather becomes less of a problem than in winter and early spring months.

The semi-permanent subtropical anti-cyclone is well established over the South Atlantic in May. Westerly systems are too weak to penetrate the strong ridge of high pressure extending westward across the Gulf of Mexico, and the season is too early

for easterly systems to exert an important influence on the weather; consequently, May can be considered as having the fairest weather of the year.

c. <u>Summer</u>

Easterly circulation is predominant in June so that easterly disturbances and occasionally more intense tropical disturbances begin to appear in the Gulf of Mexico during this month.

There are no significant differences in the number of tropical disturbances, amount of cloud cover, or visibility between June and July. Because of warmer sea surface temperatures, air mass thundershower activity increases during the period from early morning to early evening.

The Azores-Bermuda high is very strong during July and August and dominates the weather pattern over the Gulf as discussed earlier.

Easterly disturbances and tropical storms in the Gulf of Mexico increase significantly in August and reach a peak in September. Tropical storms follow two principal paths into the Gulf during August, one through the Straits of Florida, the other through the Yucatan Channel. Thundershower activity is slightly more frequent than in July, and occurs mainly from early morning to mid-afternoon.

d. Fall

The July-August weather pattern just discussed continues on through September. Easterly disturbances and tropical storms reach their peak frequencies during this month. Thundershower activity decreases from the August frequency and occurs earlier in the day.

October is the transitional month, when easterly systems weaken, and westerly systems are not yet strong enough to reach the Gulf with any regularity. Continental air masses, usually of the Pm type, may occasionally move over the Gulf and produce several days of nearly cloudless skies. Tropical disturbances may still enter the Gulf during October, but their frequency in the northwestern Gulf is about one-half of September's. Very few thunderstorms occur in October.

Tropical storms seldom enter the Gulf of Mexico during November. Subtropical anti-cyclones over the South Atlantic are migratory and westerly systems control the weather in the Gulf and adjacent land areas.

2. Sky Cover and Visibility - Seasonal Variations

a. Winter

Cloud cover over the northwestern Gulf of Mexico is two tenths or less approximately 30 percent of the time, and

eight tenths or more about 40 percent of the time. Visibilities less than five nautical miles (M) are slightly more frequent in January and February than in December because of more frequent fogs induced by colder water temperatures, and are also more frequent in the coastal waters than in the central Gulf area for the same reason. In coastal waters, visibilities of less than five M are reported in about 15 percent of ship observations during January and February, compared to 10 percent in waters further offshore. During December, a visibility of less than five M is reported about 10 percent of the time with less geographic variation.

b. Spring

Considerable cloudiness persists through April, but breaks off sharply in May. Sky cover of two tenths or less occurs approximately 30 percent of the time. In May, two tenths or less sky cover is reported about 30 percent of the time, but the percentage frequency of cloud cover eight tenths or more decreases to only 20 percent. Visibilities improve sharply in April, compared to March, as the sea surface temperatures rise. Frequency of visibilities less than five M is 10 percent in March and five percent in April in the northwestern gulf. During May, restrictions to visibilities rarely occur except possibly under infrequent thundershowers.

c. Summer

The frequency of sky cover two tenths or less over the northwestern Gulf Coast is about 30 percent, and the frequency of sky cover eight tenths or more is about 20 percent. No restriction to visibility occurs except in heavy rainshowers.

d. Fall

September visibilities and sky cover are similar to those present in summer. During October and most of November, cloud cover two tenths or less is reported by approximately 50 percent of the ship observations off the middle and upper Texas Coast, and the Louisiana Coast. Farther offshore, the frequency of cloud cover eight tenths or more is about 30 percent. Advection and frontal fogs begin to appear in November, reducing the visibility to less than 5 M about 10 percent of the time near the coast and about 5 percent of the time farther offshore.

3. Surface Wind Patterns

The Azores-Bermuda atmospheric high pressure cell dominates the circulation over the Gulf, particularly during the spring and summer months. In late summer there is a general northward shift of the circulation and the Gulf comes under the more direct influence of the equatorial low pressure belt. During the relatively constant summer conditions, the southerly

position of the Azores-Bermuda cell brings about predominance of southeasterly winds. The winds tend to become more southerly in the northern part of the Gulf. Typical summer and winter circulation patterns are shown in Figs. 11 and 12.

A more detailed display of frequency of wind direction and velocity in the Galveston area is shown in Fig. 13.

During winter, winds usually blow from easterly directions with fewer southerlies but more northerlies. Winds from west and southwest are rare anytime during the year.

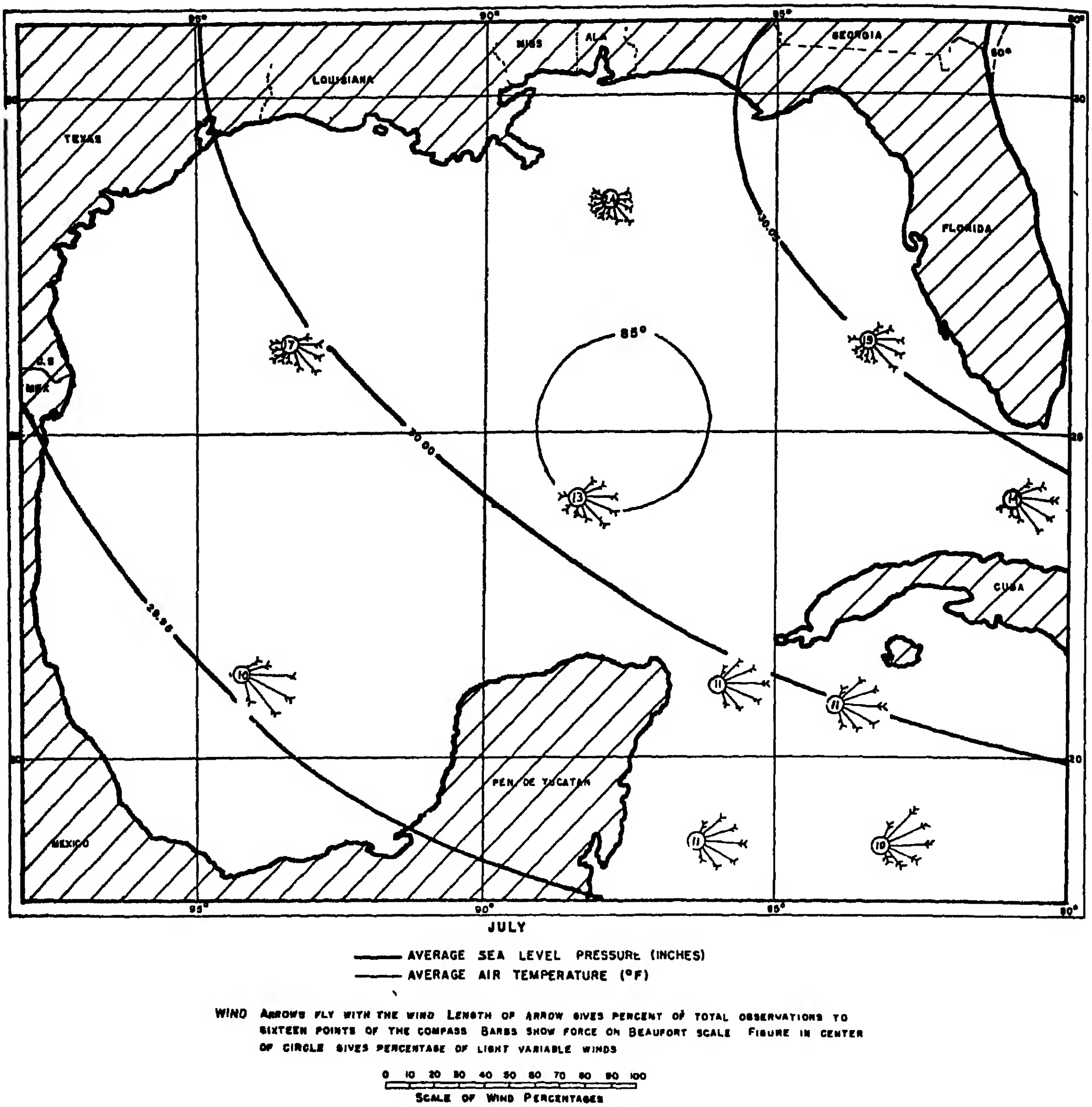


Figure 11 Average Atmospheric Conditions over the Gulf of Mexico in July (from Leipper, 1954a).

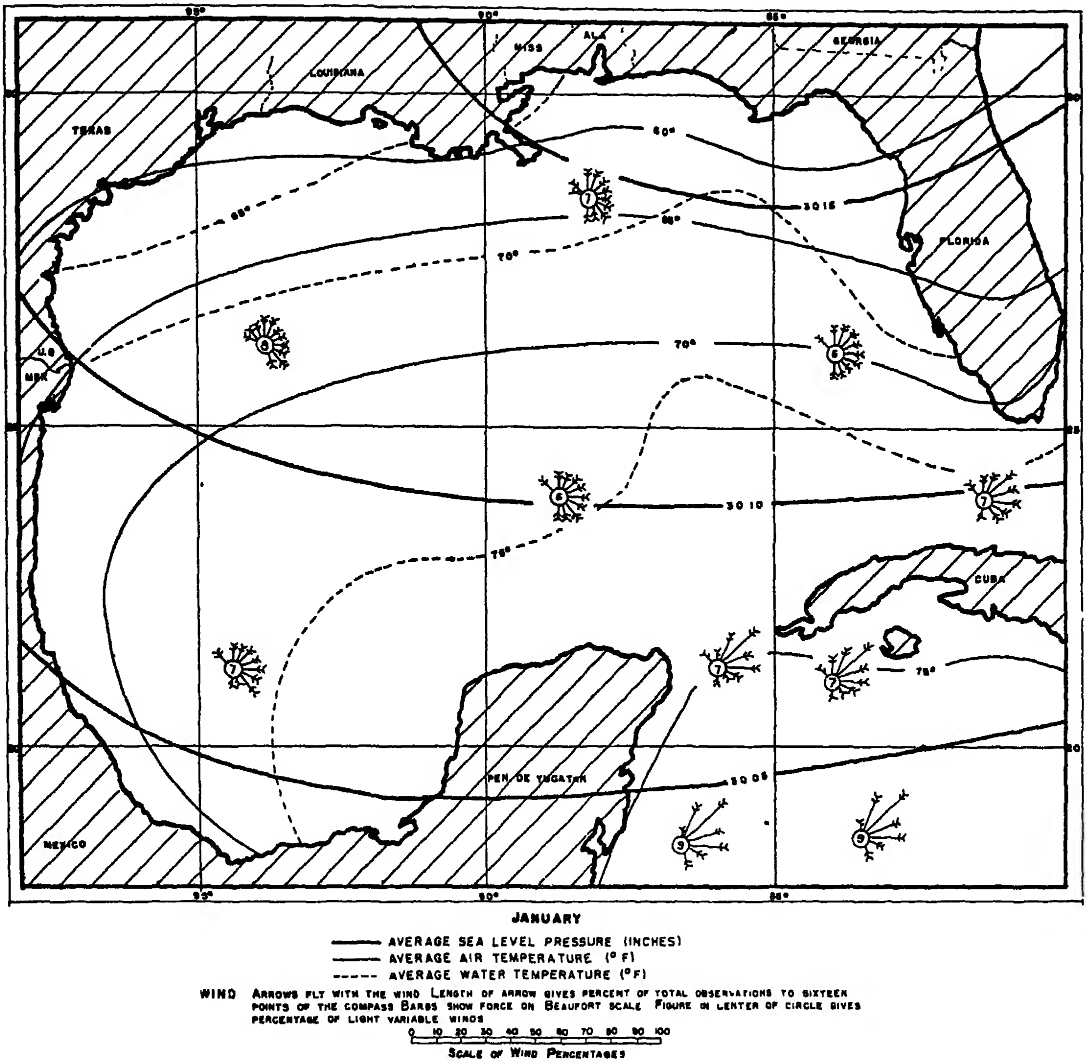


Figure 12. Average Atmospheric Conditions over the Gulf of Mexico in January (from Leipper, 1954a).

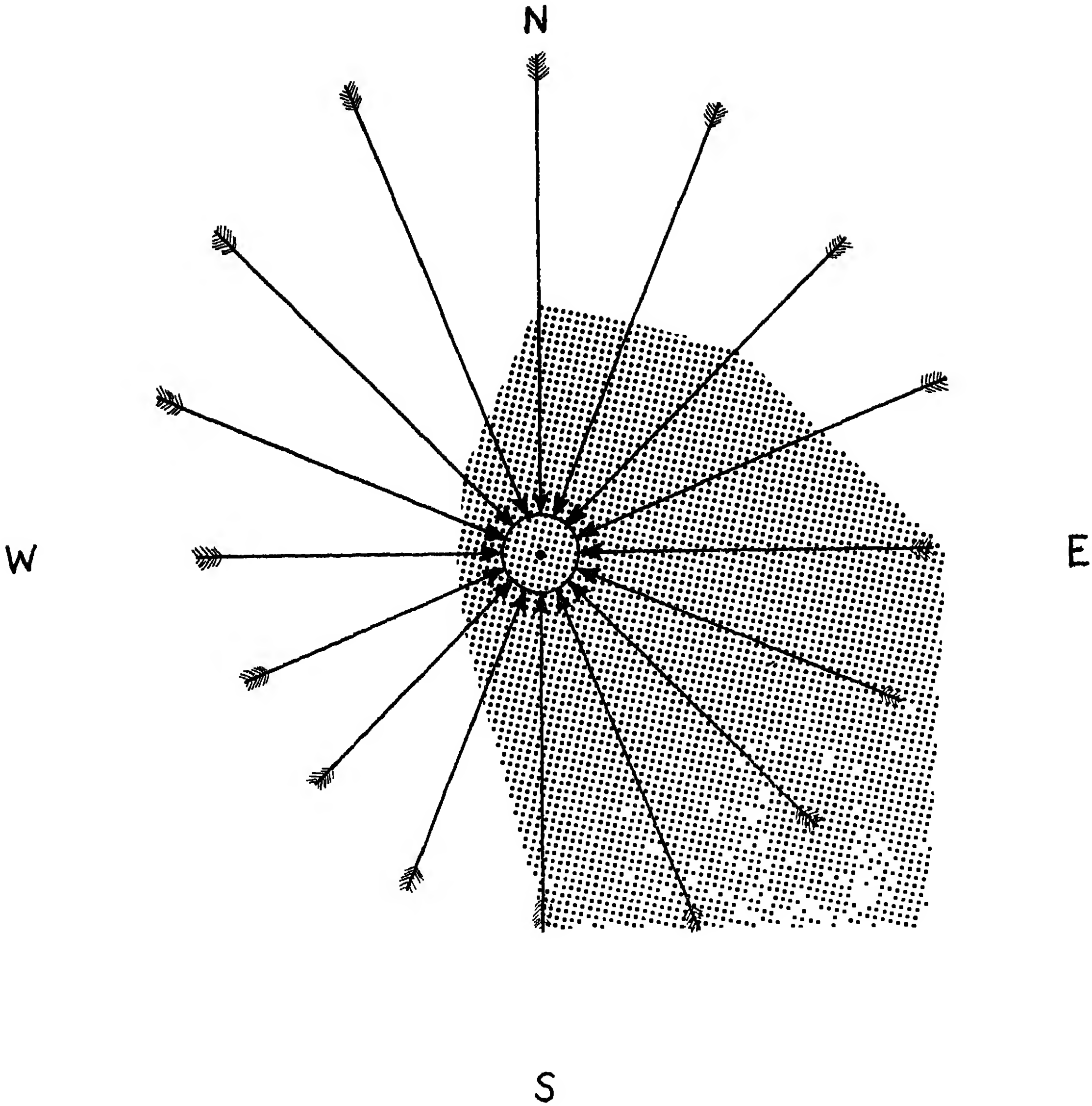
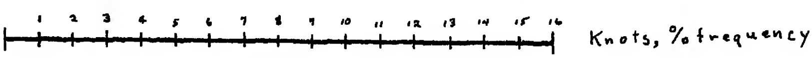


Figure 13. Frequency of Wind Direction and Velocity (From Texas A & M Univ., 1972).

Legend: Length of arrow projected to center point = velocity in knots.

Circumference of stippled area connects points on arrow shafts, measured from center, representing frequency with which wind blows in arrows' directions.

Scale



4. Surface Air Temperatures

The following table lists surface air temperatures from weather stations in four Texas counties and the western section of Louisiana adjacent to the proposed sale area. 1/

County, Station/Region	Temperature °F	
	July, Mean Max.	Jan. Mean Min.
Brazoria, Angleton	91	46
Chambers, Anahuac	91	44
Galveston, Galveston	87	49
Jefferson, Port Arthur	91	44
Western coastal Louisiana	82	53

Air temperatures over the open gulf exhibit narrower limits of variation both on a daily and seasonal basis. In July, average temperature over the center of the gulf is about 85°F and gradually increases coastward to within 10° of the coastal stations given in the table above. In January, average air temperatures over the gulf are highest in the southeast, near Cuba and the Yucatan Peninsula, and decrease toward the north. East of Brownsville/Corpus Christi, January air temperatures over the open gulf average about 65°F; at the Galveston-Mississippi Delta latitude, the temperature is about 60° F.

1/ Texas reports are from Moore (1972).

the greatest number occuring in August and September. During an average year, off the Gulf and Atlantic Coasts, there are fewer than ten tropical cyclones, of which about six develop into hurricanes. Over the last 10 years, these caused in an average year, the death of 50 persons between Texas and Maine, and property damage exceeding $400 million.

Hurricanes vary considerably in intensity, track patterns, and behavior upon crossing land, but several processes and their effects are common to all hurricanes. McGowen, et. al., (1970), in describing these processes explains that the storm approach is marked by rising tides and increased wind velocities; generally the longer a storm lingers in the gulf, the larger the bulge of water it pushes ashore as it approaches land. These storm tides are commonly higher in the bays than on gulf sea beaches, although flooding and pounding waves affect both areas. Hurricane Carla, in 1961, produced 22-foot tides in Lavaca Bay, Texas; Hurricane Celia, in 1970, produced 14-foot tides in Corpus Christi Bay, Texas; Hurricane Camille, in 1969, produced 22.6 foot - tides at Pass Christian, Mississippi.

The flood tides and high waves carry shells and sediments from deeper offshore areas onto seaward beaches, spreading a veneer of deposits over the broad, flat hurricane beaches. In the marsh areas, extensive and prolonged inundation and pounding result, with damage or loss to habitat and man-made structures within. The storm surge flood may also produce breaches or channels in natural barrier islands or in levees.

As the storm passes over the shore, the pattern of current and wave attack shifts into compliance with the direct influence of the counter-clockwise winds of the hurricane. Water and sediment are pumped out of bays and flooded areas into the gulf through passes and breaches on the left side while still being pushed shoreward or landward on the right side. The highest intensity winds are felt as the storm comes ashore, and in the vicinity of the eye, rapid changes in atmospheric pressure and the change in wind direction as the eye passes produce great stresses on structures.

No account of the effect of hurricanes on the offshore oil industry could be found for the proposed sale area, primarily because of the relatively few installations and low level of offshore drilling and production in this area. However, on August 17, 1969, Hurricane Camille passed along the eastern flank of the Mississippi Gulf Coast, passing through an area of extensive offshore activity. An account of that storm and its effects on the offshore oil industry, as described in a U.S. Army Corps of Engineers report (U.S. Army, 1970), is summarized below.

Camille's top winds were estimated at 201.5 miles per hour, and the barometric pressure in her calm eye dropped as low as 26.61 inches of mercury. The hurricane surge at Pass Christian, Mississippi, was recorded at 22.6 feet above the normal level of the Gulf. Offshore installations in areas near South Pass, Maine Pass, and Breton Sound were badly damaged. Prior to arrival of the storm, the Offshore Operators Committee advised tapering off production operations, and before the storm hit, 4,000 wells in State and Federal waters were shut-in and 3,000 workmen evacuated. Because of this caution, no injuries to petroleum production

personnel were reported and there was a total absence of blowing wells and few leaking wells. The U. S. Geological Survey reported no oil slicks in Federal waters and only one in State waters.

During the onslaught of Camille, one production platform was destroyed and two were damaged, two drilling rigs were destroyed, and three were damaged. Also in the area were seven drilling rigs that were not damaged.

When the Weather Bureau advises that a hurricane or serious tropical storm is imminent, all oil and gas facilities in or adjacent to the path of the storm are evacuated. Upon evacuation, all surface equipment and wellhead controls are shut-in. In addition, blank tubing plugs are set in as many wells as possible to further reduce the possibility of pollution in the event the well is damaged. These tubing plugs form a seal against fluid flow.

b. Extratropical Cyclones

In addition to the tropical cyclones, extratropical cyclones that may vary greatly in intensity occur in this area primarily during the winter months. These storms have attained wind

speeds as great as 30 to 50 knots. They originate in middle and high latitudes forming on the fronts that separate different air masses. The Gulf of Mexico is an area of cyclone development during the cooler months due to the contrast in temperatures of the warm air over Gulf waters and the cold continental air over the United States. From August 1959 through April 1970, 90 such extratropical cyclones have passed within 120 miles of the Mississippi Delta Region and could possibly have affected the area.

c. Polar Outbreaks

A phenomenon known as a "norther" is quite common in the area in question during the winter months. A norther occurs when cold, polar air moves southward from the cold interior of the North American continent out over the warm waters of the Gulf. This unstable cold air mass, when heated from below, develops strong gusty northerly winds with considerable cloudiness and showers. During a typical winter as many as 30 such cold outbreaks reach the Gulf coast. The majority of these cold outbreaks, spilling out over the Gulf, produce winds in the 15-20 knot range but approximately one third of these cold outbreaks have winds over 34 knots with approximately half of these being vigorous enough to reach 48 Knots.[1/]

1/ Information obtained from Deputy Assistant Secretary of Environmental Affairs, Department of Commerce.

C. Physical Oceanography

1. Sea Surface Temperatures

Leipper (1954b) presents figures for average February and August sea surface temperatures for the Gulf of Mexico; they are reproduced on the following pages as Figs. 14 and 15. According to Leipper, the main feature of the average winter pattern is a gradual drop from approximately 75° F. in the south to 65° F. in the north in all parts of the gulf. In the summertime, average temperatures are very nearly uniform at 84° F. throughout the gulf. Years of investigations have shown that considerable deviation from these average isotherms may occur at certain times. It is well known that periodically, intense cold spells along the Texas coast can cause sufficient cooling of coastal waters to result in extensive mortality of warm-water fish with narrow limits of temperature tolerance (Gunter and Hildebrand, 1951).

In shallow coastal waters and in estuarine and marsh areas, water temperatures approximately follow air temperatures without reaching the extreme limits exhibited by air temperatures during brief periods.

2. Salinity

In the upper 50 meters (168 ft.), water in the central Gulf of Mexico typically has a salinity of very near 36.0 parts

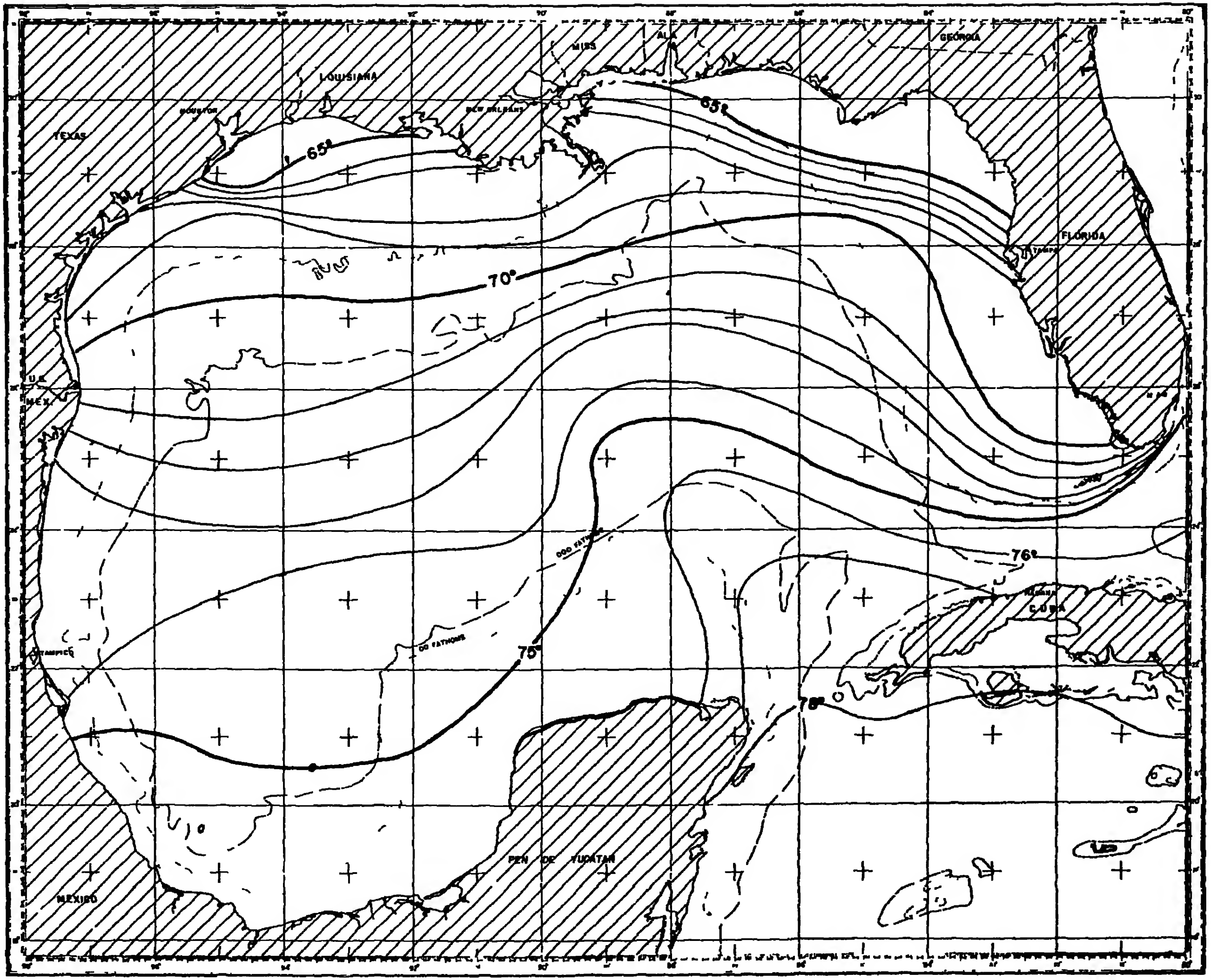


Figure 14 —Average sea surface temperatures for February (after Fuglister). (from Leipper, 1954b).

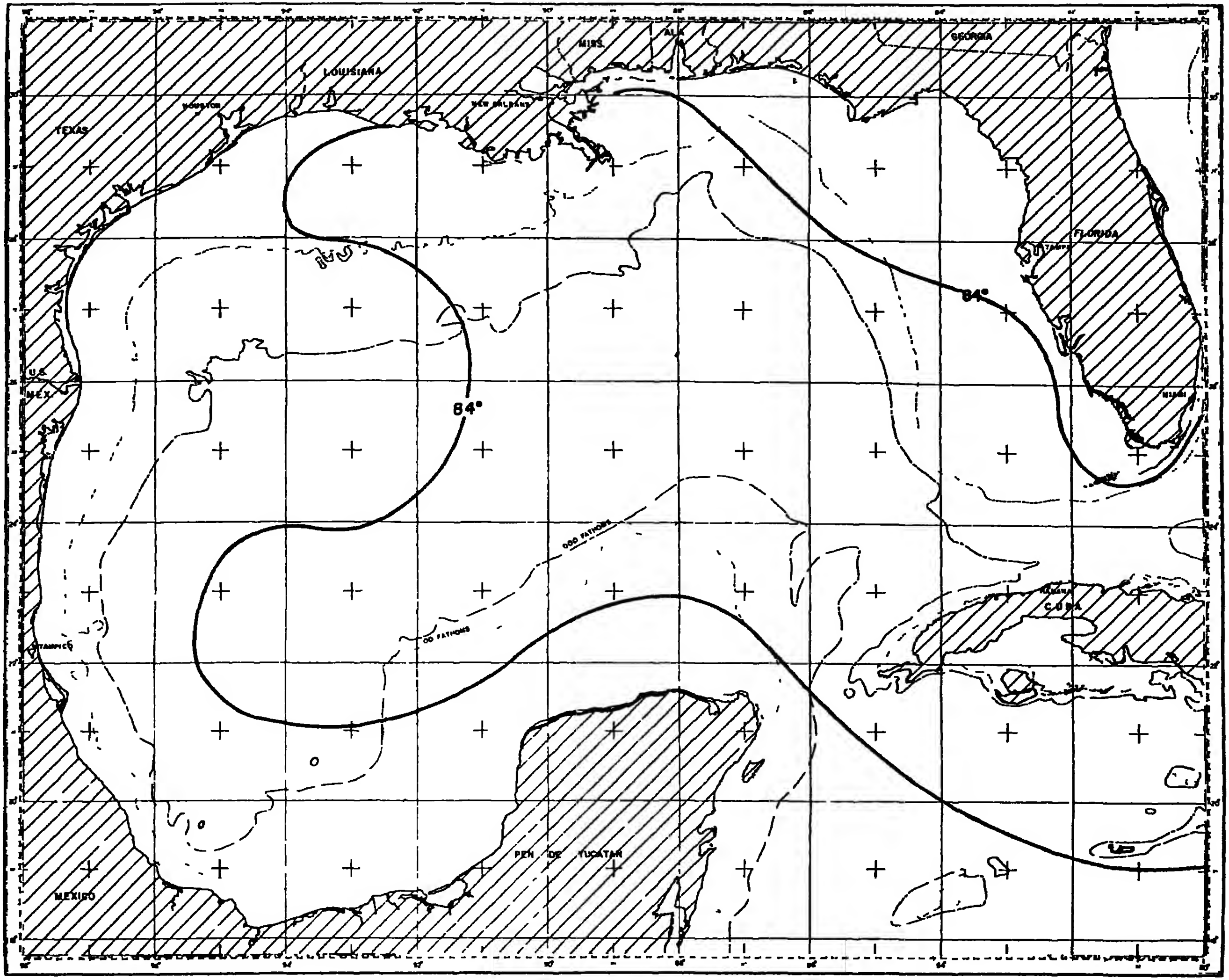


Figure 15 —Average sea surface temperatures for August (after Fuglister) (from Leipper, 1954b).

per thousand (ppt) (Leipper, 1954b; Nowlin, 1972). Salinity of waters over the continental shelf is generally lower and more variable. However, in coastal areas and lagoons of southern Texas where precipitation and run-off is low, salinities often equal or exceed those of the open sea. Research in the Port Aransas area by Jones, Copeland and Hoese (1964) showed that summer salinities (June-September) to be almost uniform, at 35 to 36 ppt from the coast to 25 nautical miles (M) offshore. Through the fall, coastal salinities decrease to about 30 ppt due to runoff and wind driven, lower salinity bay water entering the gulf. Spring brings increasing coastal salinities and a breakdown of the uniform winter isohalines. June again brings the summer salinity condition.

Highly variable nearshore salinities are also found along the upper Texas coast. Jeffery and Creager (1954) have noted that the salinity near Freeport has been found to vary from 10.5 ppt to 34 ppt daily in deep water. The average of 26 years salinity measurements at the Galveston tide station shows the salinity to be lowest (about 20 ppt) in May, followed by a sharp increase to 30 ppt in August; this is followed by a sharp decrease to about 25 ppt in October and a gradual fluctuating decline to the May value again (Jeffrey and Creager, 1954).

Salinities in western coastal Louisiana are much lower due to the influence of the extensive marsh bordering the sea, higher river flow and runoff through the Mississippi, Atchafalaya, Mermentan, and Calcasien rivers. Average salinities from one year of sampling by Louisiana Wildlife and Fisheries Commission (1971) were as follows: Sabine Pass - 17 ppt; Calcasieu Pass - 17 ppt; Lower Mud Lake on the Mermentau River - 5 ppt; Miller Lake - 17 ppt; and Portage Lake (southwest Vermillion Bay) - 3 ppt.

3. Ocean Currents

The general circulation pattern in the eastern Gulf of Mexico consists of a clockwise Loop Current entering through the Yucatan Channel and leaving through the Florida Strait. The western half of the gulf has no strong, semi-permanent currents but is characterized by a well-defined pattern of winter flow and a highly variable summer pattern (Nowlin, 1971). The winds and weather over the deep waters of the open gulf appear to enter as significant modifying forces to the broad circulation only in very unusual circumstances. The shape and size of the deep basin, in contrast, play a critical role (Leipper, 1967).

Leipper (1967) cites Cochrane (1965) in noting an annual variation in the speed of the Yucatan in flow based upon Pilot Chart data

and current and temperature measurements. Cochrane has found a maximum of nearly 36 miles per day in May and June, and a minimum of about 24 miles per day in October and November. Leipper notes that the current regime in the Gulf can be considered in two parts related to this variation in inflow speed. The first part which appears to exist most of the time, during the period of maximum flow, may be called the "Spring Intrusion". It is formed as a small loop close to Cuba in January and February and grows in size and extends continually farther out into the gulf until August. The second part of the flow regime may be thought of as the "Fall Spreading". This event occurs at least in some years beginning in August and September and continuing to February or March. It consists of a weakening and possibly a splitting of the loop flow and an extension of it into the western part of the gulf. This extension may occur by a splitting of the flow just north of the Yucatan Shelf and a turning westward of a portion of it, or it may occur by a westward bending of the entire north end of the loop or of an eddy derived from the loop.

Thus, in contrast to the eastern portion of the gulf, which is dominated by the major Loop Current system and occasional eddies, the western portion seems characterized by generally minor currents, such as regional winds and the Fall Spreading.

In attempting to characterize the general circulation over the deep portions of the western Gulf basin, Nowlin (1971) has stated that the winter current pattern of east-west flow seems typically to be of broad westward flow through the soutern part and a narrow zone of stronger eastward flow in the deep water portion of the northern Gulf. This eastward flow is separated by a strong shear zone from a narrow westward counter flow located immediately to the north, just above the continental slope. A unique summer pattern cannot be defined from existing data. It is likely that eddies drifting into the western Gulf contribute to the high degree of variability seen there in summer.

An investigation by Kimsey (1964) limited to the currents above the continental shelf of the northwestern Gulf of Mexico, involved the use of drift bottles to define the current patterns. Through the course of this study, the following seasonal patterns emerged.

During winter, surface currents over the continental shelf are along shore, westerly and southwesterly with velocities ranging from 8 to 13 miles per day (0.29-0.47 knots). Very close to shore, a northerly countercurrent is detectable in the Brownsville and Corpus Christi, Texas areas. Velocities of the countercurrent decreased along its path from about 9 miles per day (0.33 knots) at Brownsville to 1 to 2 miles per day (0.04-0.07 knots) near Corpus Christi.

Early in spring a northeastern current begins to appear offshore and converges with the southwesterly current. This current apparently contributes to the Gulf Stream, as drift bottles released off Louisiana in the investigation cited above were carried to eastern Florida beaches. As spring progresses and winter northerly winds give way to strong southerlies, the convergence moves northeastward along the Texas coast and by late spring-early summer, surface currents are strongly onshore off central Texas and obliquely onshore (NNE) along Louisiana.

Through mid-summer surface currents over the shelf are along shore, northeasterly and easterly between Brownsville, Texas, and the Mississippi River Delta.

By the end of summer, currents are again westerly and along shore, turning to the southwest along the south Texas coast. This condition prevails throughout autumn and winter.

Kimsey concluded after studying current charts of the U.S. Naval Oceanographic Office and wind records of the U.S. Weather Bureau, that the patterns of change in surface currents over the continental shelf in the northwestern Gulf of Mexico is much the same each year. He believes that variation is a matter of timing and this, in turn, is largely a function of prevailing winds.

An illustration of the current patterns just discussed are in Fig. 16 below. The table following Fig. 16 is an excerpt from the charts (Central American Waters: Current Charts", U. S. Navy Hydrographic Office Misc., No. 10. 690-1 (1942). The table indicates mean velocity (in knots), direction and number of observations off Galveston (Latitude 29° N, Longitude 94° to 95° W). Values given in the table are based on a small number of observations, mainly ship drift, which would include a wind component. Since the wind and the current would tend to be in the same direction, these values are probably higher than the actual water currents (Texas A & M Univ., 1972). The data presented in this table agrees closely with Kimsey's drift card experiments.

4. Astronomical Tides 1/

The tide-producing forces of sun and moon change from day to day in accordance with the changing positions of those bodies relative to the earth. Hence, at any given instant the tide-producing forces are distributed over the earth in a regular manner varying with longitude and latitutde. However, the response of different seas to the same set of tide-producing forces can be profoundly modified by the physiographic and hydrographic features of particular oceanic basins.

1/ From a discussion by Marmer (1954).

In the northwestern Gulf of Mexico three types of tides occur:

(1) Lake Pontchartrain, New Orleans, Port Eads, Louisiana; Round Point (Trinity Bay), Texas - DIURNAL TIDE. That is, one high and one low water occur in a day. An example is given in Fig. 17.

(2) Weeks Bay (Vermilion Bay), Eugene Island, Louisiana, South Jetty Light (Bolivar Roads), Galveston (Bay side), Carancahua Reef in West Bay, Texas - MIXED DIURNAL TIDE. That is, during about half of the days in a fortnight, there will be essentially one high and one low water per day, but during the remaining days, there will be two high waters, and two low waters per day. An example is shown in Fig. 17.

(3) Calcasieu Light (Calcasieu Pass), Louisiana - MIXED SEMI-DIURNAL TIDE. That is, two high waters and two low waters occur each day, but difference between higher high water and lower high water, and between higher low water and lower low water varies daily according to a fortnightly cycle. An example is shown in Fig. 17.

The regularity in the periodic rise and fall of the tide and its cyclic variation is subject to the disturbing effect of changing meteorological conditions. These disturbances are brought about by strong winds "piling up" water in a particular area or by a significant change in barometric pressure, the water surface being depressed by a high pressure area or bulging upward under a low pressure area.

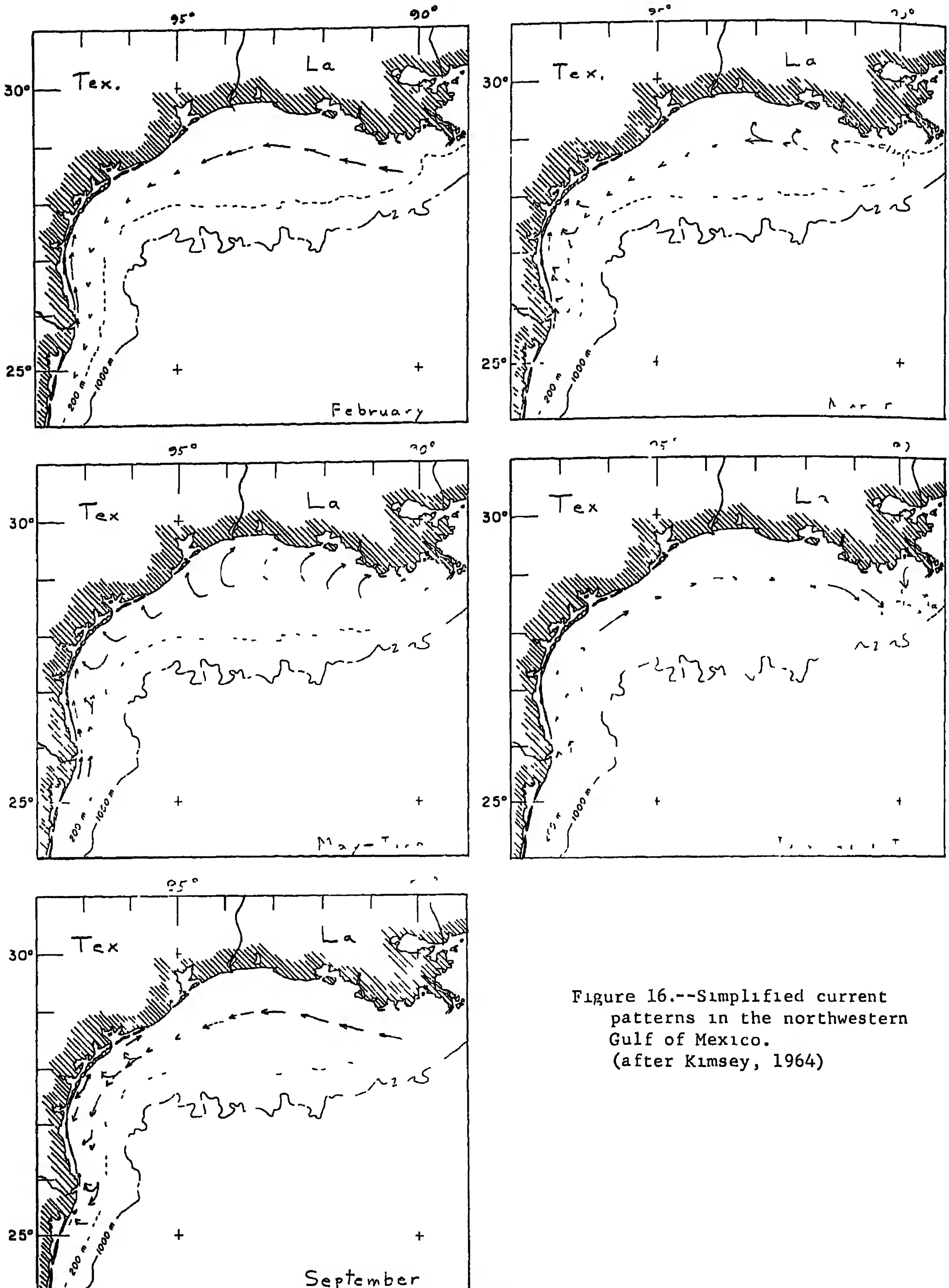


Figure 16.--Simplified current patterns in the northwestern Gulf of Mexico. (after Kimsey, 1964)

Currents off the Texas Coast Near Galveston 1/
(Latitude 29° N, Longitude 94° to 95° W)

Item 2/	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Vel	0.35	0.38	0.37	0.44	0.38	0.27	0.18	0.30	0.36	0.41	0.25	0.35
Dir	W	W	W	W	W	W	NNW	WNW	W	WSW	W	W
No. Ob.	113	127	159	169	181	177	152	179	156	139	157	114

1/ Based on "Central American Waters: Current Charts", U. S. Navy, Hydorgraphic Office Misc., No. 10, 690-1, 1942, Data to 1935; and taken from Texas A & M University, 1972.

2/ Item

Vel. - Velocity in knots

Dir. - Direction towards which current is flowing

No. ob. - Number of observations on which entry is based.

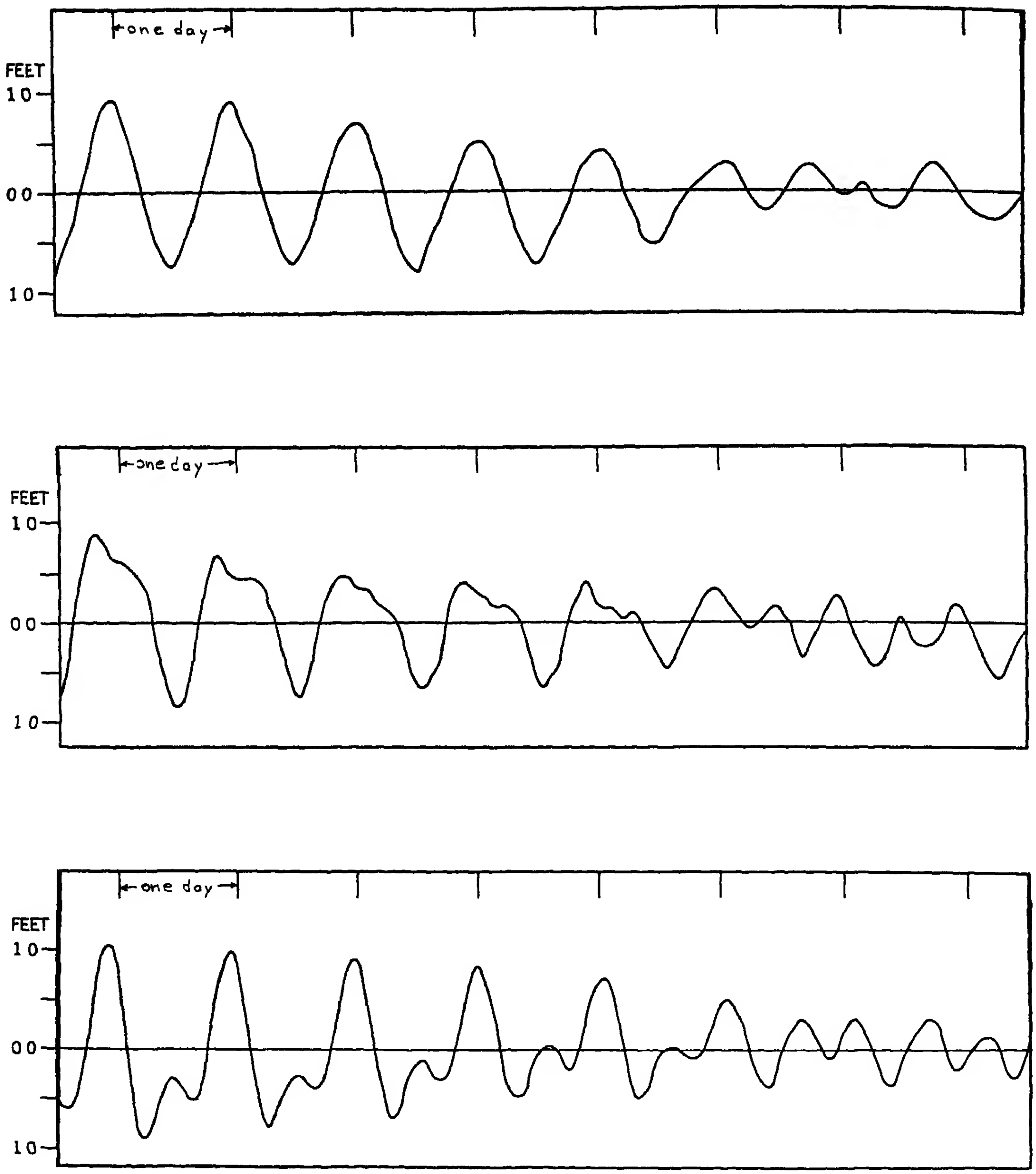


Figure 17.--Three types of tides found in the northwestern Gulf of Mexico
a. Diurnal; b. Mixed diurnal, c. Mixed semidiurnal
(from Marmer, 1954)

In an area of low tidal range such as the northwestern Gulf and its one to two foot tides, these meteorological disturbances are normally unimportant. It is only during the onslaught of an intense storm, such as a hurricane, that the normal level of the sea can be radically changed. An example is the 22.5 foot storm tide along the Mississippi coast, caused by Hurricane Camille (discussed in section II. B. 6.).

5. Ocean Wind Waves (Sea) and Swell

Both wind waves and swell are appreciably lower in the Gulf of Mexico than along the Atlantic and Pacific coasts. Jeffery and Creager (1954) noted the following characteristics about sea and swell in the Galveston-Port Arthur area. In summer, seas are low (wave heights of 1-3 ft.) on an average 70-80% of the time, and high (7-8 ft.) about 1% of the time. The swells in summer are low (1-6 ft.) at least 80% of the time and high (7-12 ft.) 0-5% of the time. During winter, seas are low 45-68% of the time and are high 4-9% of the time.

Jeffery and Creager (1954) presented a histogram of wave height frequency, originally credited to Fleming and Bates (1952), for a point southeast of Galveston. Wave heights were calculated from sea and swell observations. That histogram is reproduced here in Fig. 18.

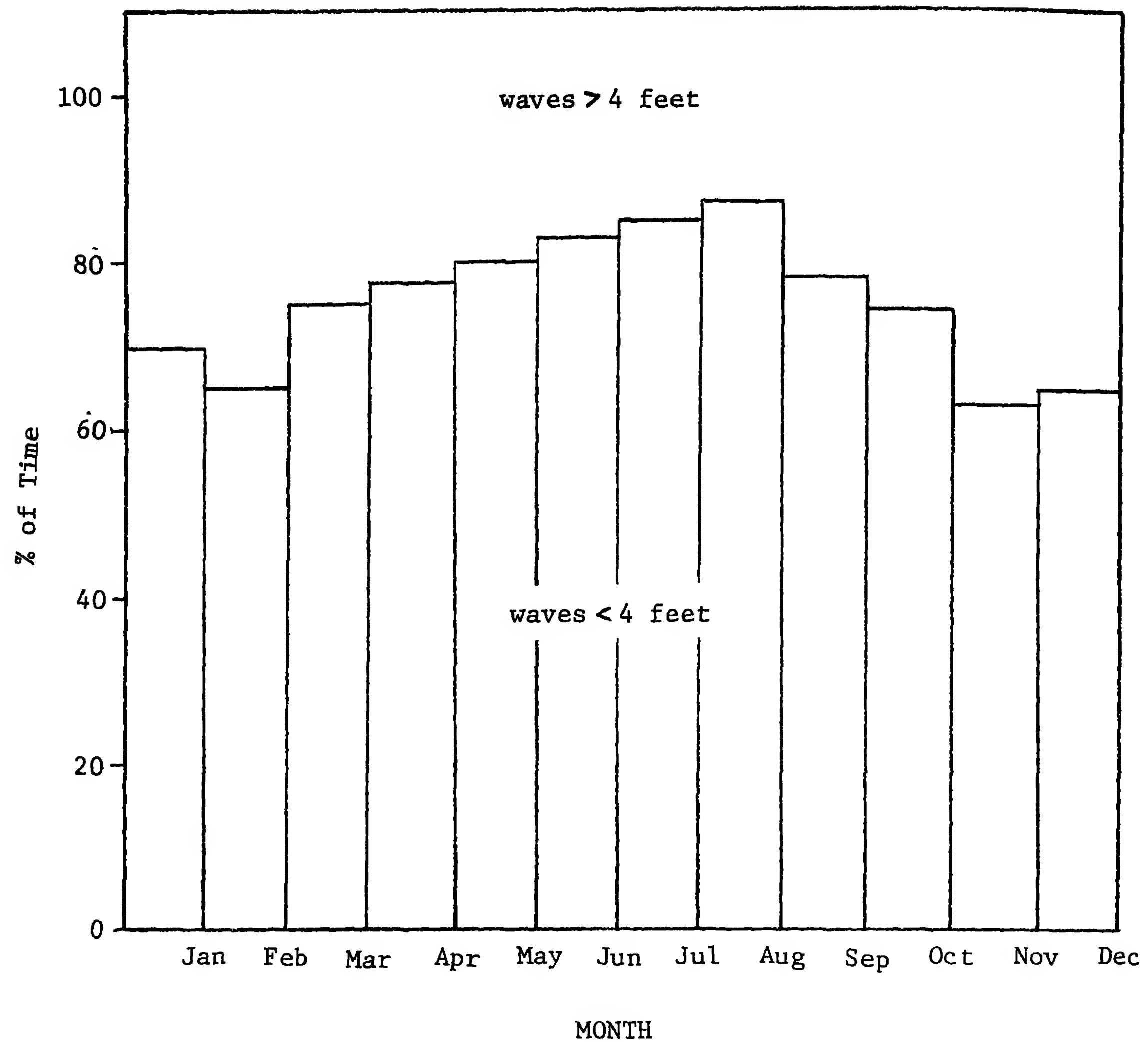


Figure 18.--Probable frequency of occurrence of waves above and below four feet in height at a location southeast of Galveston, Texas. (from Jeffery and Creager, 1954)

Storm swells of considerable magnitude occur in the northwestern Gulf often enough to merit their mention. Hurricanes occur in this area mainly from June through October with July and August being the months of greatest hurricane frequency. The average life of a hurricane in the Gulf is 9 1/2 days. Jeffery and Creager (1954) state that Galveston and Port Arthur may, on the average, expect to be affected by a hurricane every seven years. The same authors describe the resulting sea and swell as follows:

"The swells and waves generated by a hurricane travel directly forward from the right front segment of the storm at speeds estimated to be 50-60 mph., and may precede the storm by 600 miles. Both the gradually sloping regular bottom topography of the Texas coast and low gravitational (astronomical) tides keep storm tides at or below 15 feet MSL (above mean sea level). . . ."

D. Ecology of the Northwestern Gulf of Mexico and Adjacent Coastal Zone

The natural environment can be conveniently assigned to three natural subdivisions for purposes of discussion: the coastal zone, the neritic zone, and the oceanic zone; however, it should be kept in mind that there is periodic and continual exchange, throughflow and, interaction of many living and non-living components of these systems.

This discussion has been titled "Ecology ...", but it will indeed only touch upon the barest qualitative framework of the ecological systems under consideration. No attempt will be made to ascertain and include quantitative aspects such as rates of energy input or biomass, population dynamics, and limiting factors. The boundaries of the area to be discussed are roughly the arc of coastline from 92° to 96° west longitude and from five feet above MSL to the abyssal Gulf. Major biotopes are shown in Fig. 19.

1. The Coastal Zone

a. The Environment

The coastal zone includes bays, salt marshes, estuaries, barrier islands, beaches, and other shoreline features. Marshy and submerged components are characterized by low but variable salinity, and except for Galveston Bay, reduced tidal

action. Most of these biotopes receive simultaneous or intermittent inflow from both streams and from the Gulf. These conditions result in considerable sedimentary material being deposited here so that the bottoms tend to be quite muddy. Bacteria and other decay organisms break down the organic material transported from elsewhere as well as the locally produced organic material. Such areas, especially the brackish marshes, are normally zones of intense biological activity. Large populations of juvenile fish, crustaceans, and molluscs utilize these areas as nursery grounds and feed mainly upon the nutrient-rich decaying organic matter of the shallow backwaters.

The Gulf coast Prairie, according to Suter (1971), is a nearly level plain, slowly drained, and less than 150 feet in elevation, with numerous sluggish rivers, creeks, bayous and other water ways. It is characterized by level grass lands that support ranching and farming, low woodlands primarily along streams and wetlands. The climax vegetation of the Gulf Prairies is largely southern cordgrass prairie and bluestem - sacahuista prairie or post oak savannah. However, in Texas, much of the area has been invaded by trees and brush such as mesquite, oaks, prickly pear, and several acacias. Woodlands along streams and wetlands may consist of pine, willow, ash, cottonwood, live oak , bald cypress,

and others. Further discussion of this upland area will not be made because any impact from the proposed leasing action is considered to be minimal in this area. The remainder of this discussion will be restricted largely to areas below the five foot topographic contour.

b. Communities of the Coastal Zone

(1) Prairie Marsh of Western Louisiana

The following account of this area is taken primarily from O'Neil (1949). The general character of this marsh is one of shallow peat spoils ranging in depth to five or six feet. The entire marsh floor is near sea level and poorly drained which results in deep, stable water levels. All high ground in the marsh is confined to stranded ancient sea rims, or chenieres, the present day sea-rim, natural levees along rivers and bayous, and "made" land (dredging spoil piles, filled areas, etc.).

An area somewhat representative of the entire prairie marsh near the mouth of the Mermentan River has been chosen for detailed discussion here. In order to simplify the discussion, a cross-section of a transect is shown in Figs. 19-20. The sea-rim, region 1, is comparatively low, about two to three feet above normal high tide.

(a) Producers

Sea-rim marshes are dominated by comparatively narrow zones of various species of marsh vegetation.

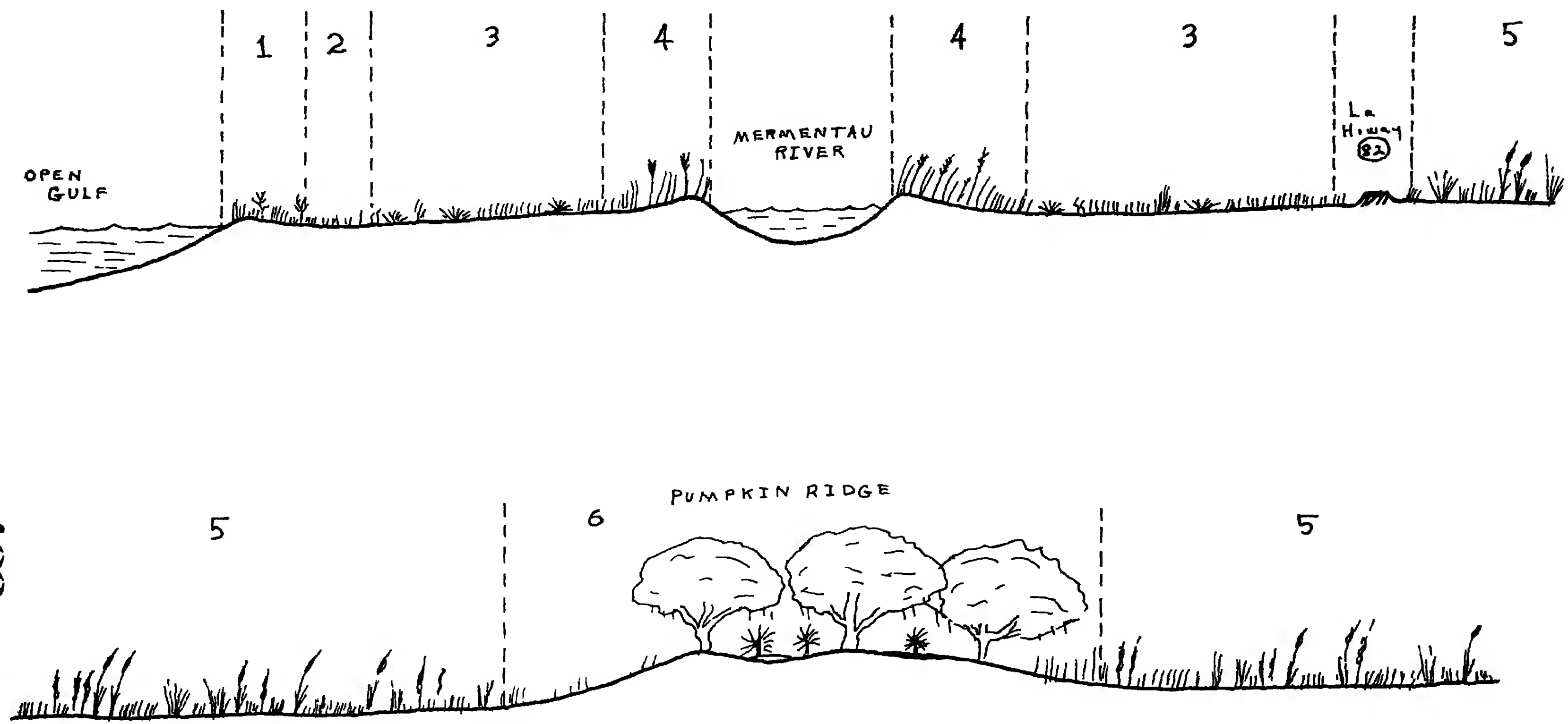


Figure 20.--Transect (a) of Figure 19: Cross-section of Prairie Marsh of Western Louisiana.

The crest is protected against wave action by growths of buckbrush (Baccharis halimifolia) associated with hogcane (Spartina cynosuroides) and oystergrass (Spartina alterniflora). Behind this is the excessively drained salt marsh, region 2, where highly saline mineral deposits have been brought ashore by each high tide. This narrow band supports a salt grass (Distichlis spicata), oystergrass, wiregrass (Spartina patens) association. The next region, numbered 3, is the brackish marsh, where the climax vegetation is wiregrass (Spartina patens). However, annual intentional burning of the marsh during the summer dry season results in a subclimax vegetation of three-corner grass or rush (Scirpus olneyi), or coco (Scirpus robustus), which is more desirable as muskrat habitat. The natural levees and banks of bayous and the Mermentau River (region 4) in the brackish marsh are vegetated by roseau cane (Phragmites communis) and hogcane. The inner banks of bayous, and the river are populated by mud algae, usually diatoms (Chrysophyceae) and blue-green algae (Cyanophyceae), and the brackish, bayous and river waters and marshy areas where ponding has taken place have marsh grasses and phytoplankton producers. Another important group of algae is the epiphytic "slime" of filamentous green algae and diatoms growing upon the submerged stems of the marsh grasses.

Louisiana State Highway 82 apparently diminishes the free circulation of water in the marsh in this area because it roughly marks

the transition from the previously discussed brackish marsh and a fresh water marsh (region 5). The vegetational association of this marsh is of canouche (*Panicum hemitomon*), cattails (*Thypha* spp.), bull-tongue (*Sagittaria lancifolia*), spike rushes (*Eleocharis* spp.), yellow cutgrass (*Zizaniopsis miliacea*), saw grass (*Cladium jamaicense*), roseau cane, and bulrush (*Scirpus californicus*). Aquatic species of producers include submergents: coontail (*Ceratophyllum demersum*), water milfoil (*Myriophyllum spicatum*), pond weeds (*Potamogeton* spp.), and the floating duck-weed (*Lemna* spp); and algae: filamentous floating and attached green algae, planktonic green algae, planktonic, benthic, and epiphytic diatoms, floating, epiphytic, and benthic bluegreen algae, and rare occurrences of other groups.

About four miles further inland, through the freshwater marsh, the next region (no. 6) is a chenier, Pumpkin Ridge. As stated earlier, chenieres are ancient sea-rims that were stranded behind an advancing shoreline. Along with natural and artificial levees, and the modern sea-rim, they are the only elevated, relatively dry areas in the marsh. Chenier vegetation consists of short-meadow-like grasses and forbes with live oak (*Quercus virginiana*) and dwarf palnetto (*Sabal minor*) dominating the view. Beyond the chenier, the fresh water marsh continues.

(b) Consumers--Divergent Food Chains

Odum (1961) cited studies which showed that less than 5% of net production of marsh grass (*Spartina*) is consumed "on the stalk" by insects and other grazers. Most of the marsh primary production is channeled through the detritus food chain. (As grass dies and falls into the water, the abundant microogranisms convert it into particles rich in bacterial and algal growth and containing abundant proteins, carbohydrates, and vitamins.) Thus, whether marsh production is finally channeled into predatory fish, hawks and owls, alligators, or human food stuff, nearly all of it passes from marsh grass through the detrital food chain and then upwards.

In the brackish river, bayous, and ponds, sampling by the Louisiana Wildlife and Fisheries Commission (1971) indicates the primary aquatic consumers are largely comprised of a few species of copepods (mostly *Acartia tonsa*, plus *Labidocera aestiva*, *Centropages* sp, *Corycaeus* sp., *Eurytemora* sp., and *Tortanus* sp.) and a few other members of the zooplankton such as *Oikopleura* sp. These animals and others are also involved in the detrital food chain, as they normally include both particulate organic matter plus living phytoplankton in their diet. Other organisms feeding partly to largely on detritus are clams, various worms (Annelida:Polychaeta: Sedentaria, nemitodes, turbellarian flatworms), crabs, grass shrimp and amphipods.

Preying on the planktonic herbivores and detritus, feeders are various jelly fish, comb jellies (ctenophores) arrow worms (chaetognaths), larval and juvenile decopod crustaceans (blue crabs, white, and brown shrimps), grass shrimp, larval fish of many species, small predatory fish (especially the tidewater silver sides, Menidia beryllina and bay anchovy, Anchoa mitchilli), and the filter feeding fish, especially the menhaden (Brevoortia patronus).

In the position of secondary and tertiary aquatic consumers and perhaps even higher are the predatory fishes and larger invertebrates. Louisiana Wildlife and Fisheries Commission (1971) has found 43 species of fish and large swimming or crawling invertebrates by trawling and seining surveys of which, most belong here in the food chain. Quantitatively, the more important species are the sand weakfish (Cynoscion arenarius), spot (Leiostomus xanthurus), atlantic croaker (Micropogon undulatus), mullet (Mugil cephalus), adult white and brown shrimp (Penaeus setiferus and P. aztecus), and blue crabs (Callinectes sapidus). This is an over-simplification, however, because some species are quite omnivorous, such as the spot, which was found by Parker (1971) to feed upon detritus, vascular plants, algae, other fish, protozoans, worms, snails, clams, insects, barnacles, shrimp, zooplankton, and

hydroids. These types of animals may not strictly be assigned to a given trophic level. These trophic labels of convenience cannot be strictly applied to each species.

Curl and Small (unpublished manuscript) have aptly stated:

> "For the most part we do not find simple food chains, each link leading to a higher trophic level organism. Instead, we find food webs in which it is difficult to find all of the links or to assign them to particular levels. The concept of trophic levels is a useful simplifying assumption, however, and permits a consideration of the cyclic flow of energy and elements in ecosystems."

Non-aquatic or semi-aquatic consumers include many species of water fowl, shorebirds, predaceous diving birds, muskrats, raccoons, alligators, nutria, rabbits, deer, frogs, snakes, turtles, mink, and wild hogs. Most waterfowl feed by browsing on vegetation and straining small organisms and detritus from the bottom muds. A few have bills equipped for catching small fish, shrimp, and other small swimming animals. The shorebirds, coots, rails, and gallinules, are mostly browsers, but many feeding habits are represented. The herons and relatives are mostly wading fish-eaters. Mink, hawks, and owls prey upon nutria, muskrat, rabbits, and other small animals. Frogs and snakes are strictly predaceous. Turtles are browsers and predaceous. Nutria and muskrats are largely browsers but will take insects, clams, and fish if convenient. Alligators, raccoons, and wild hogs are quite omnivorous, but raccoons tend not to be predatory, except on insects, fish, and shellfish. Only deer and rabbits are strictly phytophagous grazers.

All of the above except the rabbits, deer, hawks and owls, raccoons and wild hogs belong essentially to the open marsh community. Only the feeding activities of the latter group constitute an interaction with strictly aquatic community in the river, bayous and ponds.

Only deer, rabbits, many insects and a few species of snakes, frogs, turtles, the hawks and owls, and small perching birds belong to the minor dry land chenier community. The modern sea-rim probably doesn't constitute a community because members of most trophic levels spend parts of the life cycles elsewhere or are merely casual feeders.

(2) Strand Plain Chenier Marsh of the Northeastern Coast of Texas 1/

The second section of northwestern Gulf of Mexico coastal zone to be discussed is that stretching from the eastern end of East Bay (Galveston Bay) to the vicinity of the 94° west meridian near the edge of the Sabine Pass-associated chenier-mud flats. A "typical" transect (No. 2 of Fig. 19) is shown in Fig. 21.

This area differs from the Mermentau River transect of Louisiana in several ways. The marsh is not nearly so extensive, about 4 miles wide as compared to 25 or 30 in Louisiana. The sea rim contains an extensive fore beach, foredune·ridge, and sandy strand plain flat, most of which rise to over five feet above sea level. The marsh behind is either brackish or salt, and the supply of fresh water is less.

(a) Primary Producers

The beach, region 1, is mostly barren, but may have sea oats (*Uniola paniculata*) and other halophytes present.

Behind this region is the vegetated strain plain flat. It contains three subregions based upon elevation, exposure to wind

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1/ Information for this section is largely from Fisher *et. al.*, (1972), Jeffery and Creager (1954).

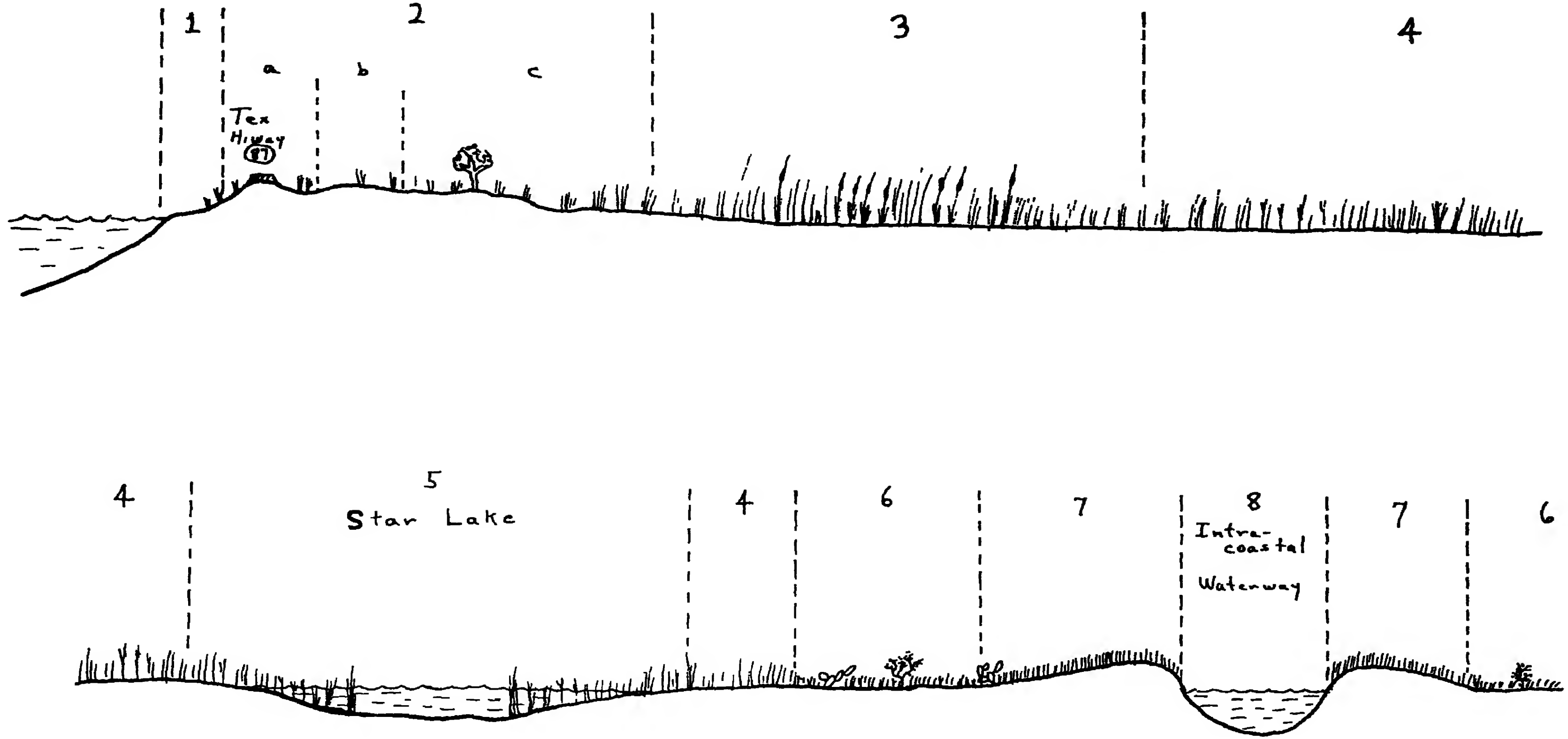

Figure 21.--Transect (b) of Figure 19: Cross-section of Strand Plain Chenier Marsh of the Northeastern Coast of Texas.

and spray, availability of subsurface moisture, and perhaps other factors. Region 2a is the foredune ridge, topped by Texas Highway 87 in this locale. Region 2b is the beach ridge and region 2c is the vegetated flat. All of region 2 is sparsely vegetated, the least growing in 2a and the most in 2c. Plants growing here include the halophytic grasses bluestem (*Andropogon littoralis*) and sea oats, gulf-dune paspalum (*Paspalum monostachyum*), coastal sandbur (*Cenchrus incertus*), milkpea (*Galactia* sp.), groundsel (*Senecio* spp.) and sumpweed (*Iva ciliata* var *annua*). Infrequently, mesquite (*Prosopis* spp.) and live oak can be found.

Region 3 is a brackish to fresh water marsh, the salinity varying with amount of precipitation, amount of time since last high storm tide, and location within this region. Vegetation here includes the glasswort (*Salicornia bigelovii*), coastal sacahuista (*Spartina spartinae*), marsh bay cordgrass (*Spartina patens*), big cordgrass (*Spartina cynosurides*) bullrushes (*Scirpus* spp.), cattail (*Typha latifolia*) and rushes (*Juncus* spp.). In submerged areas the benthic, epiphytic, and planktonic algae occur in the same way as previously described for the Mermentau River transect in Louisiana coastal marsh.

Region 4, the closed brackish water marsh, is very slightly lower in elevation than region 3 and has a chain of small brackish ponds,

many of which are connected by bayous. The transect under discussion crosses one such pond, Star Lake, which is connected to others by Salt Bayou. This region, like number 3, receives water from flooding storm tides, precipitation and runoff. Being slightly lower, it is the catch basin for this water and is hence, a slightly saltier, closed system. Vegetation within consists of marsh hay cordgrass, big cordgrass, salt grass (*Distichlis spicata*), and rushes. The region being perennially wet, also has a population of epiphytic, benthic, and planktonic algae. Star Lake itself (Region 5) is very shallow and has marsh vegetation encroaching along its edges. The usual algal populations occur in the pond also.

Just beyond Star Lake is the beginning of the coastal prairie grasslands (Region 6). Dominant members of the vegetational association here are bluestem and indian grass (*Sorghastrum* spp.). Subordinate members are paspalum, mesquite, johnson grass (*Sorghum halepense*), hackberry (*Celtis* spp.), huisache (*Acacia farnesiana*), and cactus.

Region 7 and 8 are the Intracoastal Waterway and its dredge-spoil banks. The banks are vegetated largely by prairie grasses and the waterway is largely barren.

b. Consumers

The beach and strand plain flat, (Regions 1 and 2) constituting the sea rim, is much more extensive than that in western Louisiana, and can probably be considered a minor community, rather than an assemblage of a few resident plants and animals plus occasional or casual visitors. Faunal members of the seaward portions of this community are clams (Donax), snails (Terebra, Oliva, Polinices spp.), the ghost and sand crabs (Octopode sp. and Emerita sp.) and shorebirds, and other animals, mostly casual visitors. Primary production from dunes is not enough to sustain the animals living here and a considerable amount of nutrient materials is imported from the sea. Also, scant moisture in these regions would preclude the effectiveness of the detrital food chain shunt. The vegetated flat supports populations of rodents and probably rabbits as herbisores, with predators being mostly snakes, hawks, and owls.

Herbivorous grazers of region 3, the brackish to fresh water marsh are mostly nutria, muskrat, and the swamp rabbit (Sylvilagus aquaticus), and numerous species of waterfowl. Predtors. are again snakes, predaceous diving birds, hawks, owls, and rarely mink. Alligators, largely omnivorous, occur in some parts of the marsh and in east Texas lakes and streams. Another omnivore here is the gulf spotted skunk (Spilogale indianola).

The closed brackish marsh, region 4, apparently has nearly the same fauna as region 3, based upon the limited amount of information available at the time of this writing.

Region 6, the prairie grassland, has major herbivore populations of rodents, rabbits, quail and prairie chicken that are preyed upon by snakes, coyotes, hawks and owls.

No information could be found about fauna of the Intracoastal Waterway and its dredge spoil banks.

All of the regions mentioned above must certainly have a wider variety of animals and plants than is presented here, but information for the segment of Texas coastline from High Island to Sabine Pass is very scant. No information whatsoever could be found for open water areas in the brackish marsh, such as Star Lake in the transect, but certainly, they must contain a complete aquatic system with import and export from and to the surrounding marsh and upland. It can be assumed however, that these ponds and bayous are of minor importance as habitat for species of animals spending part of their lives at sea and part in estuarine areas, such as the white and brown shrimp, because communication with the sea is indirect and tortuous, through Salt Bayou, several ponds, and Sabine Pass.

(3) Trinity River Bay-head Deltaic Marsh and Swamp

This section of coastline is somewhat remote from the proposed sale area, but is an integral part of the bay system and will be given brief attention here. Most of the information given here, along with the simplified transect (transect c of Fig. 19 and Fig. 22) is from Fisher *et. al.*, (1972).

Region 1 is Trinity Bay and will be discussed elsewhere except to mention here that its edge marks the beginning of a salt-water marsh, and that it receives considerable nutrient import from marsh and swamp and stream above.

a. Primary Producers

Region 2 is the salt-water marsh which corresponds roughly to an area from 6 inches below mean bay water level to just above high tide level. Vegetation here is cordgrass, glasswort, seepweed (*Suaeda* spp), maritime saltwort (*Batis maritima*) sea oxeye (*Borrichia frutescens*).

According to Renfro (1959), the salt cordgrass is the only species growing partly submerged in bay waters, probably because of the general turbidity of the water and the unsuitable bottom sediments.

Region 3 is a brackish water marsh. Near its upper limit, it grades into a fresh-water marsh, but near its lower limits, it

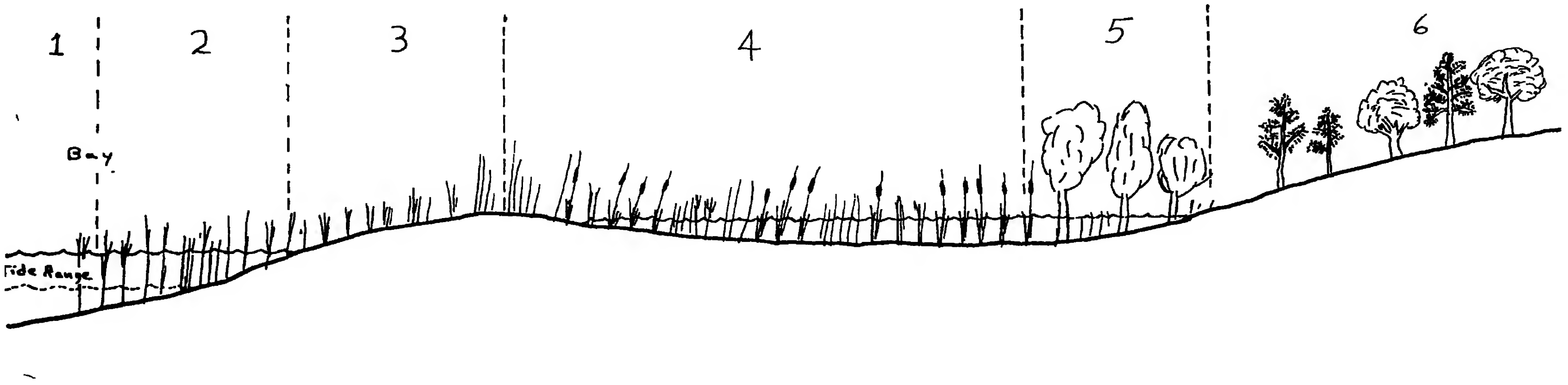

Figure 22.--Transect (c) of Figure 12: Cross-section of Trinity River Bay-head Deltaic Marsh and Swamp.

approaches a closed brackish water marsh. Thus, vegetation gradually changes from the more salt-tolerant spartinas of the salt marsh through the euryhaline spartinas and saltgrass and rushes to the more oligohaline coastal sacahüista, spartinas, cattails, bullrush and rushes.

Region 4 is an inland fresh-water marsh and receives bay salt water only rarely during high hurricane tides. Most of the water is supplied by precipitation and river run-off. Dominant plants here are rushes, bullrush, cattails, and sloughgrass (*Spartina pectinata*). Toward the upper end, where the wetland is more poorly drained, a swamp has developed (Region 5). The swamp association includes cypress (*Taxodium distichum*), Elm (*Ulmus* spp.), water oak (*Quercus nigra*), gum (*Nyssa biflora*), dwarf palmetto, mulberry (*Morus* spp.), grape (*Vitis* spp.), and yaupon (*Ilex vomitoria*).

Above the swamp is a mixed pine and hardwood forest (Region 6).

(b) Consumers

Salt water marsh consumers are waterfowl and probably marine snails, small crabs, grass shrimp and large populations of larval marine fishes and crustaceans. Besides eating the marine grasses, the waterfowl most likely graze the populations of small molluscs and crustaceans. Other grazing and predation

only results from visits to this region by non-members of the salt marsh community.

The brackish and fresh water marsh offers a larger variety of food, heavier cover, and more high ground (levees on the Trinity River) than the salt water marsh and hence has a larger variety and standing stock of fauna members. In wetter areas there are aquatic animals feeding on both living vegetation and detrital material; nutria, muskrat, and waterfowl may also feed, in part, on living vegetation. Secondary, tertiary, etc. consumers can include more omnivorous waterfowl, muskrat in part, rarely mink, snakes (especially cottonmouth), predaceous diving birds, and hawks and owls. In the swamp, in addition to these animals, but excluding most waterfowl, there are also raccoons, squirrels, and perching birds.

The faunal components of the mixed pine-hardwood forest community includes insects, spiders, and their relatives, assorted reptiles, quail, hawks, assorted perching birds, rodents, rabbits and coyotes.

4. Galveston Island - A Barrier Island

Transect No. 4 of Fig. 19, as shown in Fig. 23, is typical of barrier islands and peninsulas along the central and eastern Texas coasts. Compared to the three areas discussed above, the productivity is somewhat lower in this transect.

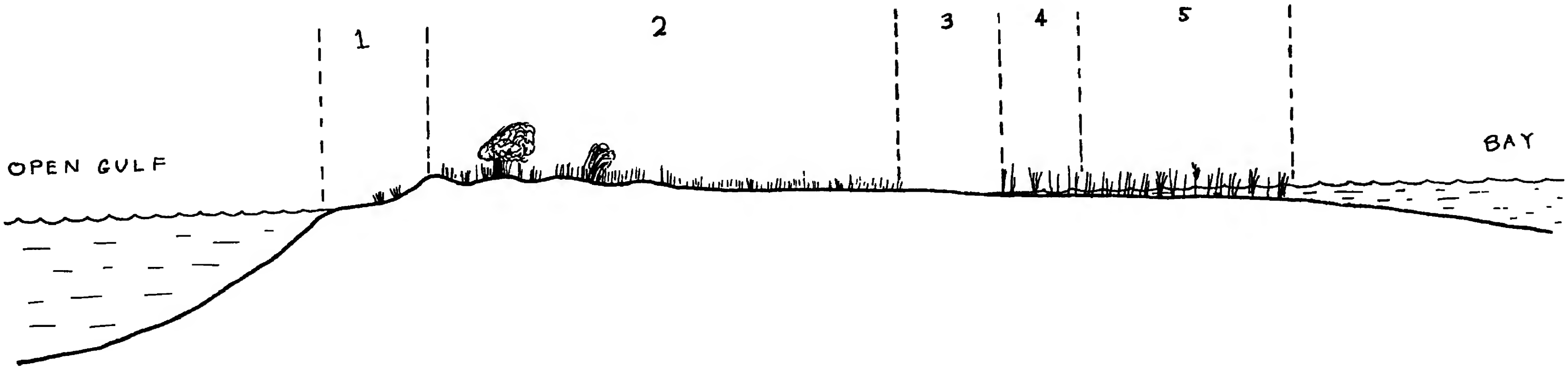

Figure 23.--Transect (d) of Figure 12: Cross-section of Galveston Island--A Barrier Island.

Region 1 is the beach, 2 is the beachridge and barrier flat, and 3, the wind-tidal flat. The beach, up to the beachridge, is sparsely populated by sea oats and a few other salt-tolerant plants. From the beachridge, through the barrier flat and up to the wind-tidal sand flat, the vegetation consists of moderate to dense stands of salt tolerant grasses with scattered live oak and mesquite. The wind-tidal sand flat is only a few inches above sea level and supports a blue-green algal mat.

Region 4 is a salt marsh. According to Fisher (1971) these marshes display an orderly plant succession from the bay line to the higher wind-tidal flat. Beginning at the edge of the wind-tidal flat the plants are (1) sea-oxeye, seepweed, *Monathocloe*, (2) maritime saltwort, glass wort, salt grass, and (3) salt cordgrass.

Below the salt marsh is the shallow bay margin is a densely vegetated grass flat (region 5). Species here can include several marine grasses (*Diplanthera wrightii*, *Ruppia maritima*, *Thalassia testudinum*).

(b) *Consumers*

As in other areas, beach infauna includes several clams and snails, and perhaps ghost crabs, along with shorebirds of various kinds. The shorebirds and ghost crabs also inhabit the drier beachridge and barrier flat, along with occasional rodents and snakes. The wind-tidal flat may have a few fiddler crabs and occasional shorebirds.

The grass flats are populated primarily by marine aquatic species, especially molluscs. Also in the region are a few visiting shorebirds and several fish. There are probably extensive visits by heron-like predaceous diving birds.

(5) The Galveston-Trinity Bay-Estuary-Lagoon System

Fisher et. al. (1972) describe this system as a relatively low-energy (waves) environment protected on the seaward side by well-developed barrier islands and peninsulas. Water exchange between the bays and Gulf is normally limited to tidal passes through the barrier islands. During storms Gulf waters also enter the bay through washovers and breaches cut through the barrier islands. Fresh water is supplied to the system by larger river systems terminating at the bay-heads, and by several small streams draining local areas of adjacent coastal uplands. Bathymetry and average surface salinity are shown in Fig. 24.

The bay margin consists of local beaches, relict berms and bay margin deposits, and small alluvial fans and fan deltas. According to Fisher et. al. there are about 50 square miles composing a band of shoal water at the bay margin, generally less than 2 to 3 feet in depth and commonly only a few inches deep. These shoal waters support fairly extensive marine algal and grass beds. The Galveston Island grass flats are vegetated chiefly by *Diplanthera*, while dominant vegetation off the Trinity delta and Clear Creek, generally in waters of lower salinity, consist chiefly of *Ruppia*. Local areas of shoal sand flats along Galveston Island

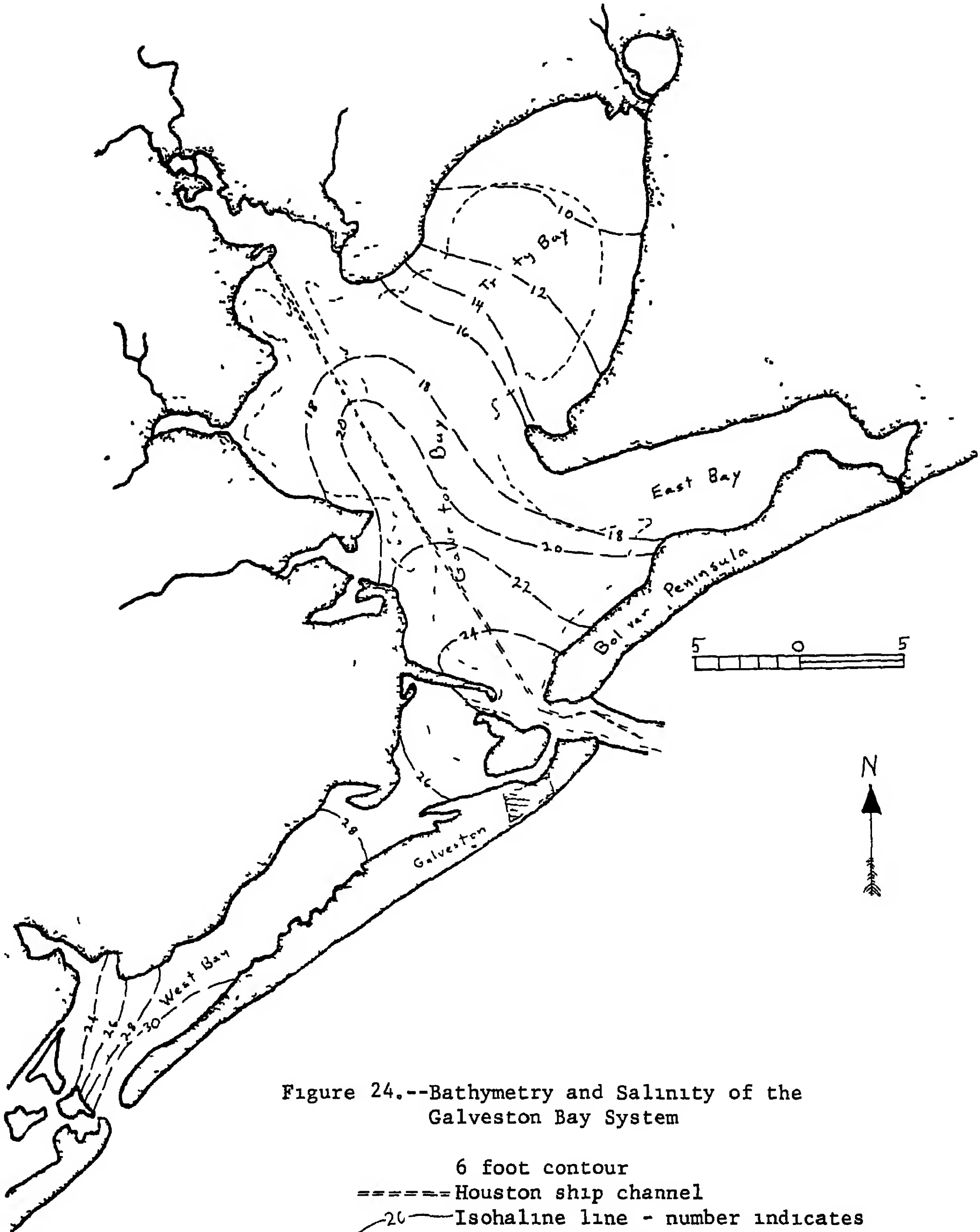

Figure 24.--Bathymetry and Salinity of the Galveston Bay System

6 foot contour
======Houston ship channel
20——Isohaline line - number indicates calculated average surface salinity in ppt. (After Fisher <u>et</u> <u>al</u>., (1972).

support only sparse marine grass cover. Renfro (1959) found beds of sea lettuce (Ulva lactuca) growing in winter on firm sandy or clay bottoms along the Clear Creek, Houston Point and Smith Point bay margins. He also found salt-cord grass (Spartina alterniflora) growing throughout the on- or near-shore and marshy areas of upper Galveston and Trinity Bays. Renfro considers the widgeon grass (Ruppia maritima) to be the most important component of the flora in the upper bays. It is most wide spread and luxurient during the warmer months and as winter approaches most of the plant growth is sloughed off and the grass mats diminish. The Ruppia beds serve as an important nursery, offering a sheltered environment to many species of larval fish and crustaceans. In this area of abundant fresh and detrital vegetation are found amphipods, small Penaeid shrimp, small crabs, worms, grass shrimp and young fish.

Other marsh and marine flora noted in the upper bays by Pullen (1960) were Lyngbya sp. a blue-green alga that was commonly found in summer months attached to mud and shell in the marsh areas; Enteromorpha sp. a green alga found in spring, summer and fall on sand and mud in shallow waters; Polysiphonia sp., a red alga common in summer and attached to pilings, piers,

and stalks of *Spartina*; and several marine grasses already mentioned in the Galveston Island transect.

Much of the bay margin of East and West Bays has been disturbed by dredging and spoil banks of the Intracoastal Waterway and is apparently relatively barren.

Distribution of the above marine vegetation is shown in Fig. 25.

No information could be found concerning species, numbers, and distribution of phytoplankton in the bay system.

The faunal components of the bay system communities are extensive and diverse. Out of almost 200 entries in a check list of invertebrate species, Shidler (1960) lists the following as abundant or very abundant:

Jellyfish

unidentified hydromedusae (jellyfish)
cabbagehead jellyfish (*Stomolophus meleagris*)

Anemones, Corals, etc.

sea Pansy (*Renilla mülleri*)

Combjellies

Mnemiopsis macradyi

Snails, conchs, whelks, periwinkles:

marsh periwinkle (*Littorina irrorata*)
zebra periwinkle (*L. ziczac*)

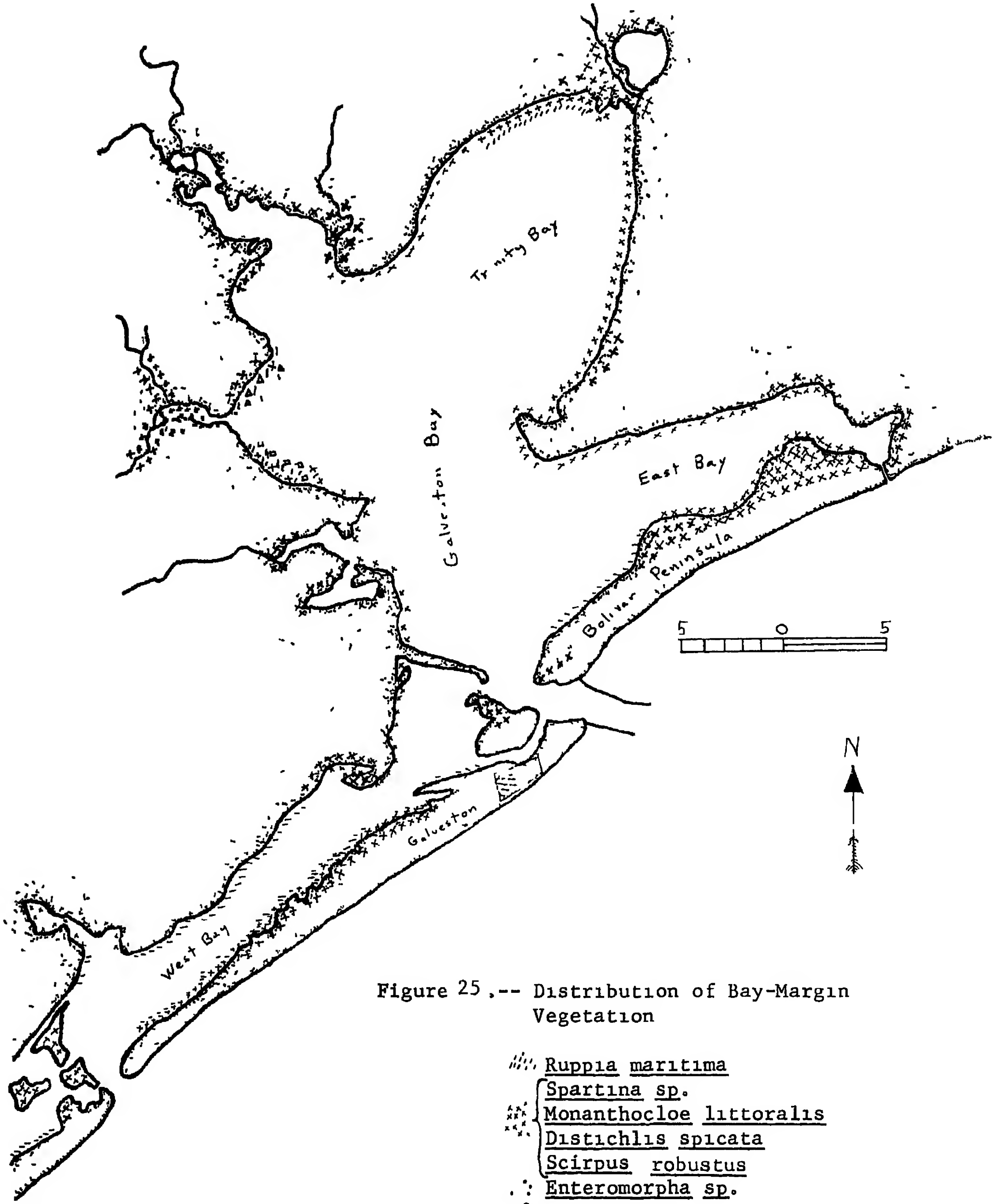

Figure 25 .-- Distribution of Bay-Margin Vegetation

- Ruppia maritima
- Spartina sp.
- Monanthocloe littoralis
- Distichlis spicata
- Scirpus robustus
- Enteromorpha sp.
- Lyngbya sp.
- Ulva lactuca
- Polysiphonia subtilissima
- Diplanthera sp.

Littoridina sphinctostoma

oyster conch (*Thais haemostoma*)

Limpets

false limpet (Siphonaria pectinata)

Mussels, oysters

hooked mussel (*Brachidontes exustus*)
commercial oyster (*Crassostrea virginica*)

Clams

mitchell's macoma (*Macoma mitchelli*)
coquina clam (*Donax variabilis*)
common short razor clam *Tagelus plebeius*
gulf jackknife clam (*Ensis minor*)
dwarf surf clam (*Mulinia lateralis*)
common mud clam (*Rangia cuneata*)

Barnacles

Balanus improvisus
Chthamalus fragilis

Isopods

sea roach (*Lygida exotica*)

Shrimp

white shrimp (*Penaeus setiferus*)
brown shrimp (*P. aztecus*)
grass shrimp (*Palaeomonetes pugio*)

Crabs

hermit crab (*Clibinarius vittatus*)
blue crab (*Callinectes sapidus*)
mud crab (*Eurypanopeus depressus*)
fiddler crab (*Uca pugnax*)

The high rate of biological productivity in this bay-estuary-lagoon system, and the extensive development of the detrital food chain is reflected in the very large and diverse bivalve populations. No information could be found on the zooplankton of the bay system.

Pullen (1960) compiled a check list of vertebrates from the Galveston bay system which included over ninety species of sharks, fresh water fish, marine fish, and a porpoise.

The list included representatives from all levels of the marine consumer food chain. There are omnivores such as the bull shark (Carcharhinus leucas) and sea catfish (Galeichthys felis), detritus and plankton feeders, such as the striped mullet (Mugil cephalus), menhaden (Brevoortia patronus), carp (Cyprinus carpio), and bay anchovy (Anchoa mitchilli) and a variety of predators including spanish mackerel (Scomberomorus maculatus), atlantic croaker (Micropogon undulatus), and white crappy (Pomoxis annularis). The single species of porpoise included on the list was Tursiops truncatus, the bottle-nosed porpoise.

Another type of community in the bay system is the oyster reef. Fisher et. al. (1972) describe them as follows: 1/

1/ Pg. 50 of Fisher et. al. (1972).

"A significant environment within Galveston, Trinity, and related bays is reefs built chiefly of the oyster (Crassostrea virginica ... These form 23 square miles of reefs ranging in size from small clumps a few feet in width to complexes up to 5 miles in diameter. Reefs vary in plan from circular to elongate, with the smaller reefs tending to be circular and the larger reefs elongate. Where elongate in plan, the axis of the reef is commonly transverse to the dominant current direction. Oysters are sessile or attached organisms and dependent on circulating waters both for food and for removing waste materials. Favored bottoms for oyster-reef development are either fine, stable sands, or stiff, compact muds. Soft mud substrates or shifting sand bottoms are not conducive to reef growth and support. Another important factor in oyster reef growth and development is water salinity. Oysters exist in a wide range of water salinity from 5% to 30+ (part per thousand)."

Hoffstetter (1959) noted at least 29 species of animals associated with the reef community, not including plankton. He listed the most abundant animals as barnacles, bryozoans, and mussels.

Periodically the oyster predator conch, Thais haemastoma, becomes moderately abundant. Mud crabs and blue crabs were also common. Annelid worms were also abundant in all reefs studied.

Approximate location of reefs is shown in Fig. 26.

There are several other bodies of water along the coast, in the area of coastal zone under discussion, such as East Matagorda Bay, Sabine Lake, Calcasieu Lake, Grand Lake and White Lake that are brackish and support communities of plants and animals similar to those in the Galveston Bay system, but they are so remote from possible impact caused by the proposed sale, that no discussion will be given for them. Also, no information of any kind could be found for the area between West Galveston Bay and East Matagorda Bay, which includes the Brazos River Delta at Freeport.

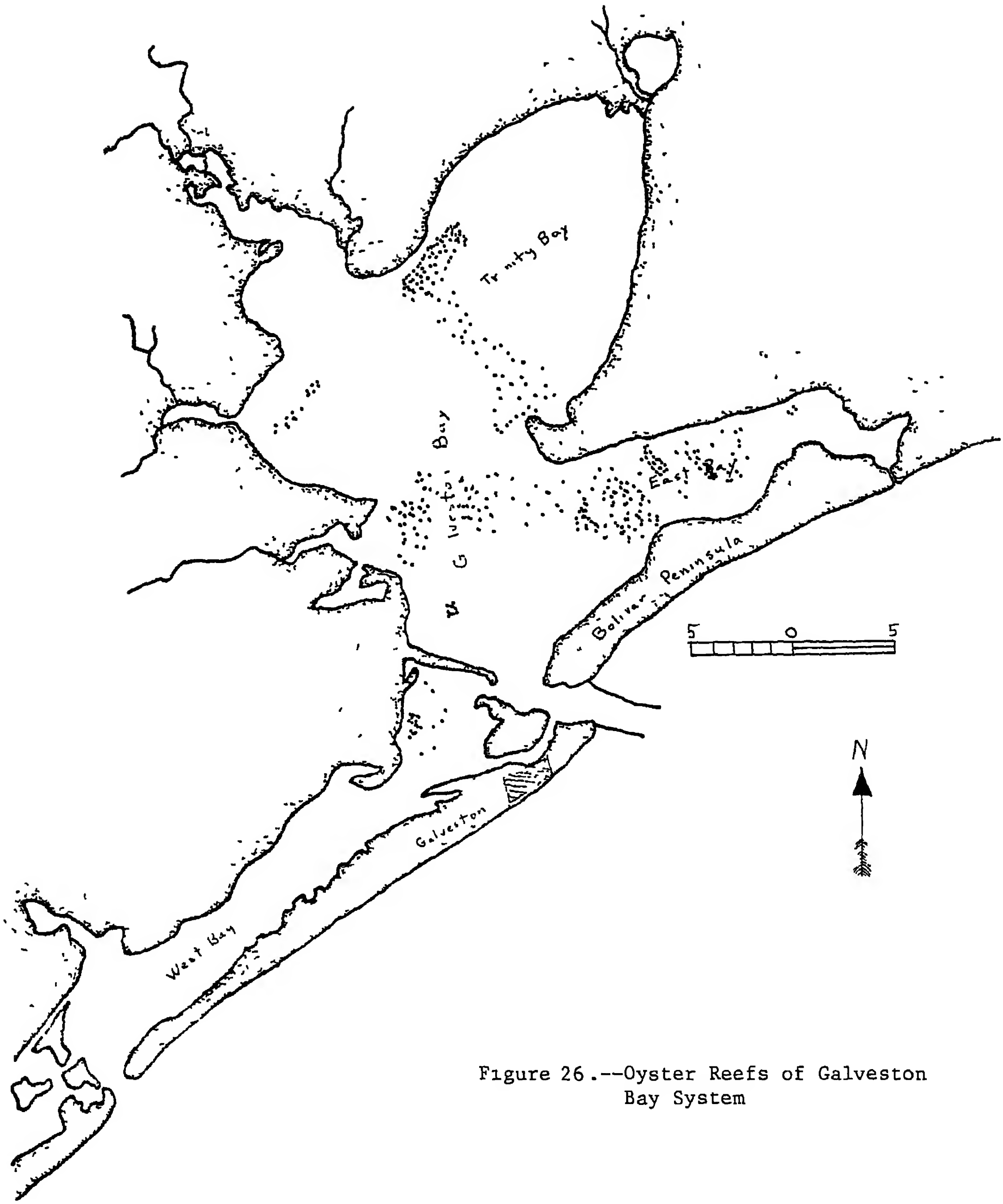

Figure 26.--Oyster Reefs of Galveston Bay System

2. The Continental Shelf and Neritic Waters

a. The Environment

The natural continental shelf includes the zone of ocean floor extending from the line of permanent immersion to the depth, usually about 120 m, (394 feet) where there is a marked or rather steep descent toward the great depths (Sverdrup, Johnson, and Fleming, 1942).

The sea above the continental shelf is usually referred to as the neritic province. The nature of shelf waters is somewhat variable being influenced by land drainage from streams and by water over neighboring portions of the shelf which are transported by ocean currents. Salinities are usually lower, sometimes markedly, than in oceanic waters and undergo seasonal or sporadic fluctuations such that many of the biotal members are more or less euryhaline in nature--that is, able to endure wide ranges of salinity. Plant nutrients, nitrates, phosphorus, and so on are more readily available in the shallower inshore waters because of stream input and because of the greater possibility of return by vertical currents after they have been regenerated from the disintegrating organisms on the bottom. This factor is of the utmost importance to production of phytoplankton, especially diatoms, the foremost of the primary food of the sea.

Therefore, per unit area of the sea, the neritic province is far more productive than the oceanic province, and along with the coastal bays, estuaries and wetlands are regions of greatest importance to marine life. Here fish of greatest economic importance are taken, not only because of greater fishing effort, but also because it is their natural habitat. (Sverdrup _et. al._, 1942).

Along the northern Gulf coast, the nearshore environments tend towards high mud content and consequently, nearshore waters contain much suspended matter and are highly turbid. In contrast, sand and shell bottoms increase with distance from shore, resulting in waters with little suspended matter which are clear and deep blue. One factor limiting phytoplankton production is the availability of sunlight to power the photosynthetic machinery. The lighted upper, (_euphotic_) zone of the sea, in which photosynthetic production is greater than organic respiration and decomposition, is probably less than 1-2 meters (3-6 feet) in the highly turbid bays and estuaries of the northern Gulf coast, around 5 meters (15-20 feet) in inshore neritic waters, 25 meters (100-150 feet) in the outer neritic waters, and up to 100 meters (over 300 feet) in oceanic waters.

Organisms living in the shallow inshore waters are often exposed to extremes of environmental conditions. Extreme ranges of temperature and salinity have caused mass mortalities of fish and other animals off the Texas Coast. Nutrients are rarely limiting to phytoplankton growth and hence energy production in these waters. Towards the outer limits of the neritic province, where the waters are clear and deep, environmental conditions fluctuate within very narrow limits and change slowly, giving rise to more oceanic type biota. Nutrients are probably always limiting in these waters.

b. Communities

Major communities as defined by Odum (1959), are very hard to delineate in the ocean, and perhaps do not exist. However, Dice's (1952) community - the occurrence together of two or more related species- or Odum's minor community, is somewhat easier to identify. Also, in plankton communities or populations there is a seasonal cycle which precludes the establishment of a climax biota such as is known from land or the benthos. For the purpose of this discussion, the populations of the entire neritic province of the northwestern Gulf, and of the benthos, will be considered as communities.

(1) Producers

Dinoflagellates and especially diatoms are the source of nearly all primary production in the sea. Only locally do plants such as the seaweeds, bluegreen algae, or rooted grasses make a significant contribution to the energy economy in the marine system. In the northwestern Gulf, the coast is a broadly embayed deltaic coastal plain with extensive sandy beaches and marshes, and, no natural rocks. This, then, is the principal reason that macrophytic algae are very limited in abundance and restricted largely to jetties and piers. The genera of important neritic phytoplankton are somewhat ubiquitous in neritic waters of the worlds oceans, and the waters over the continental shelf of the northwestern Gulf contain the usual populations of *Rhizosolenia*, *Biddulphia*, *Chaetoceros*, *Coscinodiscus*, *Skeletonema*, *Stephanopyxis*, *Lithodesmium*, *Ceratium*, *Gonyaulax*, *Noctiluca*, and others.

Neritic phytoplankton undergo seasonal density cycles, as stated above. Generally, there are two major blooms per year, in spring, and fall. Studies of these blooms, and phytoplankton populations in general, have led some ecologists to believe that population size is nutrient limited. Still others, finding a rapid increase

in zooplankton grazers after the onset of a bloom, with a subsequent drop in the phytoplankton numbers, have stated that grazing pressure is probably the limiting factor. In reality, a whole family of intermediate conditions exist.

(2) Consumers

(a) Grazers--the Zooplankton

The phytoplankton grazers include animals representing all major groups. Most important are the copepods, euphausiids, mysids, pteropod and heteropod molluscs, and the salps. Locally, protozoa and larval forms of many animals can be important. Zooplankton populations normally fluctuate in size according to the abundance of phytoplankton after a short lag in time. Some plankton called holoplankton spend their entire life cycle adrift in the oceans. Others, called meroplankton do so only while microscopic, larval stages of larger sessile or swimming forms.

(b) The Bottom Communities--The Benthos

Odum (1959) describes the benthos as large numbers of sessile or relatively inactive animals which exhibit marked zonation. He asserts that bottom organisms are generally distinct for each of the three neritic zones (supratidal, intertidal, and subtidal); benthic animals do not

necessarily change gradually from one species to another, but dominants often form more or less distinct bands or zones. These zones and associated fauna are shown in Fig. 27. Only dominant fauna are listed and include species described by Hildebrand (1954) as belonging to the bottom communities of the brown shrimp grounds in the western Gulf. Hildebrand includes mobile animals such as shrimp, flounders, croakers in his bottom communities. Inter and supra-tidal species are from Hedgepeth (1954) and Odum (1959).

(c) The Active Swimmers - The Nekton

Individuals of this group commonly, but not always, range over broad areas, and in so doing, participate in several biotic communities. Examples are the semicatadromous fish such as the menhaden which are pelagic plankton larvae, estuarine juveniles, and pelagic adults. Other examples are the sharks which may cruise over broad areas of oceanic, neritic and bay waters searching for prey. Nevertheless, most nekton are limited in range by the same environmental conditions of temperature, salinity, available food materials, and type of bottom as are organisms which are less mobile.

The most important neritic nekton in the Gulf are the herring like fishes such as the menhaden (Clupeidae) and the anchovies

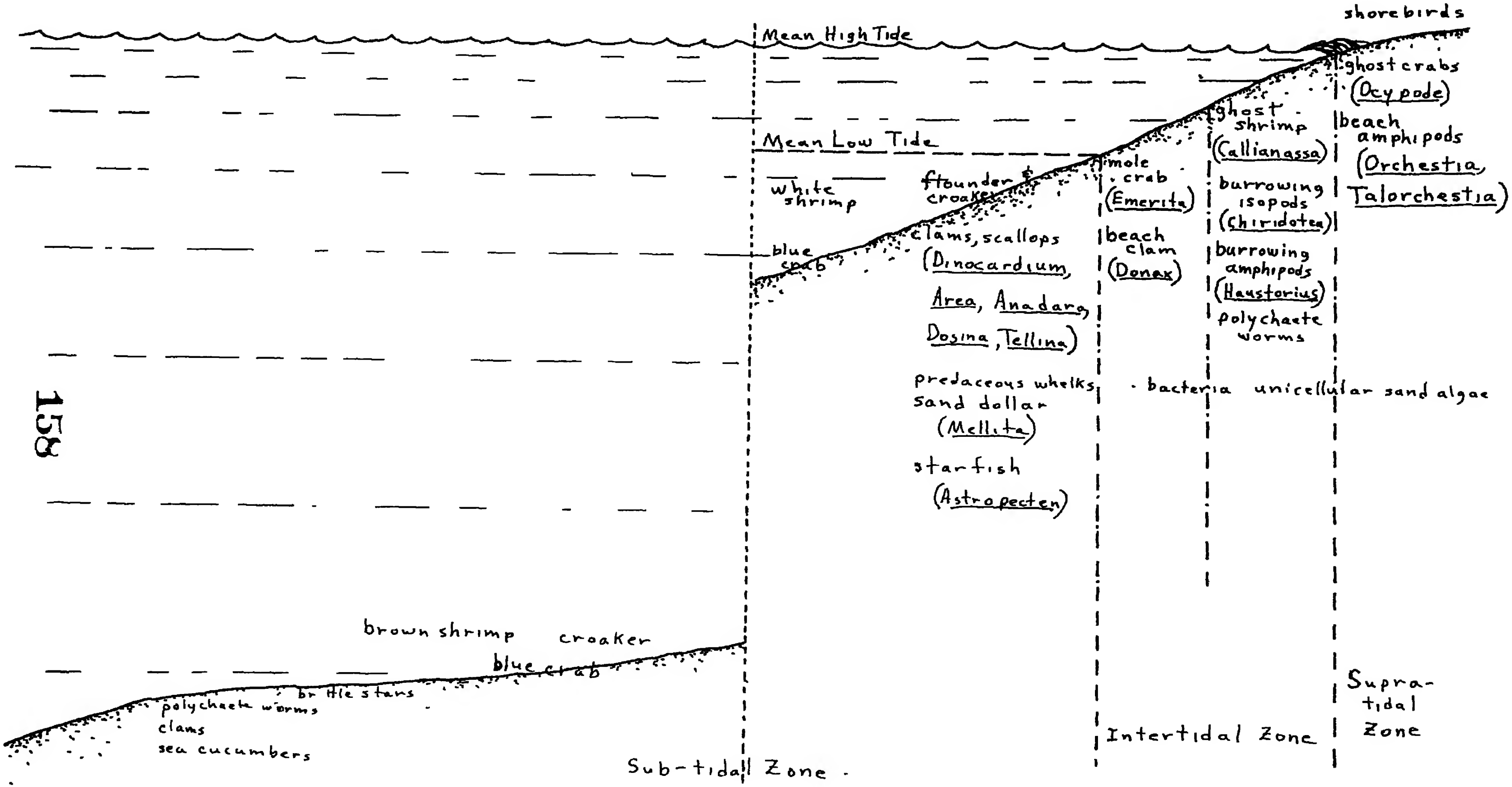

Figure 27.--Benthic Zones and Dominant Fauna
(after Hedgepeth, 1954; Hildebrand, 1954; and Odum, 1959)

(Engraulidae). These make up the larger part of the secondary consumer link in the neritic food chain and are preyed upon by a great variety and number of other fish. Some other common or abundant nektonic animals include the sharks (Carcharhinidae, Sphyrnidae), and fish snappers (Lutjanidae), groupers and sea basses (Serranidae), sailfish, marlin, and swordfish (Xiphiidae), spanish mackeral (Scombridae). Common non-fish nekton include the squids (Loliginidae), and bottlenose dolphins (Delphinidae).

Another large group of animals, while nektonic and neritic, are closely related to the benthic and near bottom communities. This group is often referred to as demersal.

Near the surf zone or intertidal areas, over sand bottoms and grass beds live the sea robins (Triglidae), gobies (Gobiidae), midshipman (Batrachoididae), sea catfish (Arridae), pipefish (Syngnathidae), and jacks and pompano (Carangidae). Below this, roughly from a few feet below low tide level nearly to the outer limits of the continental shelf are populations of sport, croakers, seatrout or weakfish (Sciaenidae), rays (Rajidae, Dasyatidae), hake (Gadidae), rabbit fish and puffer fish (Tetraodontidae), and shrimp (Penaeidae), and the families of sole and flounders (Soleidae and Bothidae) including the commercial southern flounder, gulf flounder, little flounder, ocellated flounder, whiffs, fringed flounder, hog chokers, black-lined naked sole, and tongue sole.

The abundance and distribution of demersal fishes off Louisiana and Texas were examined during 1962-1964 by Moore, Brusher, and Trent (1970). Fishes were collected monthly with a shrimp trawl at 33 to 60 stations in 7 to 110 m (4-60 fathoms) between the Mississippi Delta and the U. S.-Mexico border. The results of their findings are presented in Fig. 28.

Species that constituted one percent or more of the average catch by weight of all demersal fishes caught off Louisiana and Texas 1962–64

Species	Louisiana	Texas	Entire coast
Atlantic croaker *Micropogon undulatus*	35	9	28
Longspine porgy *Stenotomus caprinus*	18	21	19
Inshore lizardfish *Synodus foetens*	3	9	5
Sand seatrout *Cynoscion arenarius*	5	5	5
Sea catfish *Galeichthys felis*	5	2	4
Silver seatrout *Cynoscion nothus*	3	7	4
Blackfin searobin *Prionotus rubio*	4	2	4
Spot *Leiostomus xanthurus*	4	4	4
Rock sea bass *Centropristis philadelphicus*	2	4	3
Atlantic cutlassfish *Trichiurus lepturus*	2	2	2
Southern kingfish *Menticirrhus americanus*	1	3	2
Gulf butterfish *Poronotus burti*	1	4	2
Wenchman *Pristipomoides aquilonaris*	1	[illegible]	2
Shoal flounder *Syacium gunteri*	1	4	2
Mexican searobin *Prionotus paralatus*	1	4	2
Mexican flounder *Cyclopsetta chittendeni*	1	2	1
Star drum *Stellifer lanceolatus*	1	1	1
Red goatfish *Mullus auratus*		2	1
Bumper *Chloroscombrus chrysurus*	1	1	1

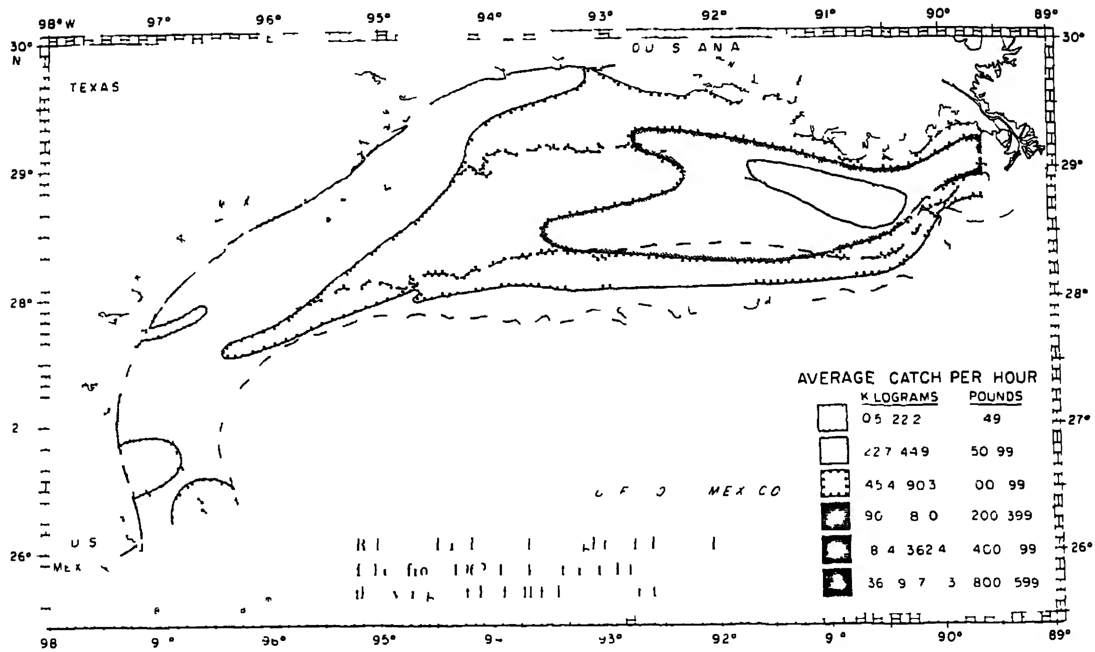

Figure 28. Distribution, relative abundance, and species composition of demersal fishes of Louisiana and Texas (From Moore, Brusher, and Trent, 1970).

c. Unique Environments - Coral Reefs

(i) Description

Between 60 and 110 nautical miles SSE of Galveston are located several prominent topographic highs which reach to within 10 to 20 fathoms of the water surface. These are members of a series of pinnacle-like banks rising abruptly from the generally smooth, sediment covered bottom near the outer edge of the continental shelf and from a broad expanse of the continental slope (Parker and Curray, 1956, Edwards, 1971). Their origin is the result of the upward thrusting of salt domes and accompanying upwarping and folding of overlying rock strata (Marine Biomedical Institute, 1971). Four banks of special interest here are shown in Figs. 29 and 30.

Of the four banks, West Flower Garden Reef has received by far the most attention from the scientific community. Edwards (1971) has determined that the West Flower Garden topographic high was formed by the intrusion of a shallow salt plug, and that the central section of the dome is a collapsed area, flanked on the east, west, and north by banks rising to within 10.5 fathoms of the surface (Fig. 31).

Edwards believes the coral reef probably constructed the upper 100 feet of the shallowest pinnacle, indicating a growth rate of 0.43 cm/yr (0.17 inch/yr) for the reef structure. The main physical

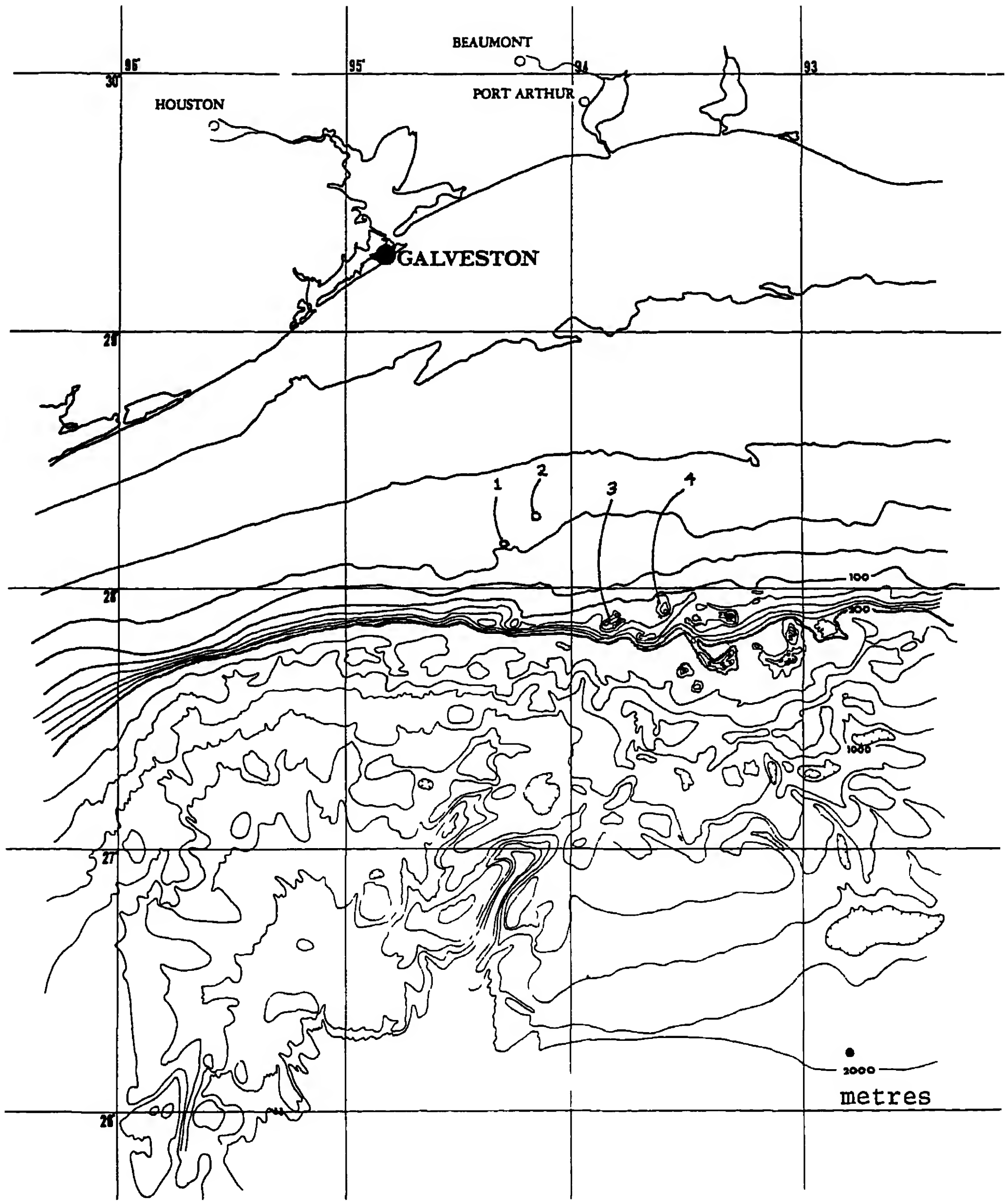

Figure 29. Approximate Location of Banks Supporting Coral Growth or Living Coral Reefs

Name	Approximate Coordinates
1. Stetson Bank	28° 10'N 94° 18'W
2. Claypile Bank	28° 20'N 94° 09'W
3. West Flower Garden Bank	27° 53'N 93° 49'W
4. East Flower Garden Bank	27° 55'N 93° 36'W

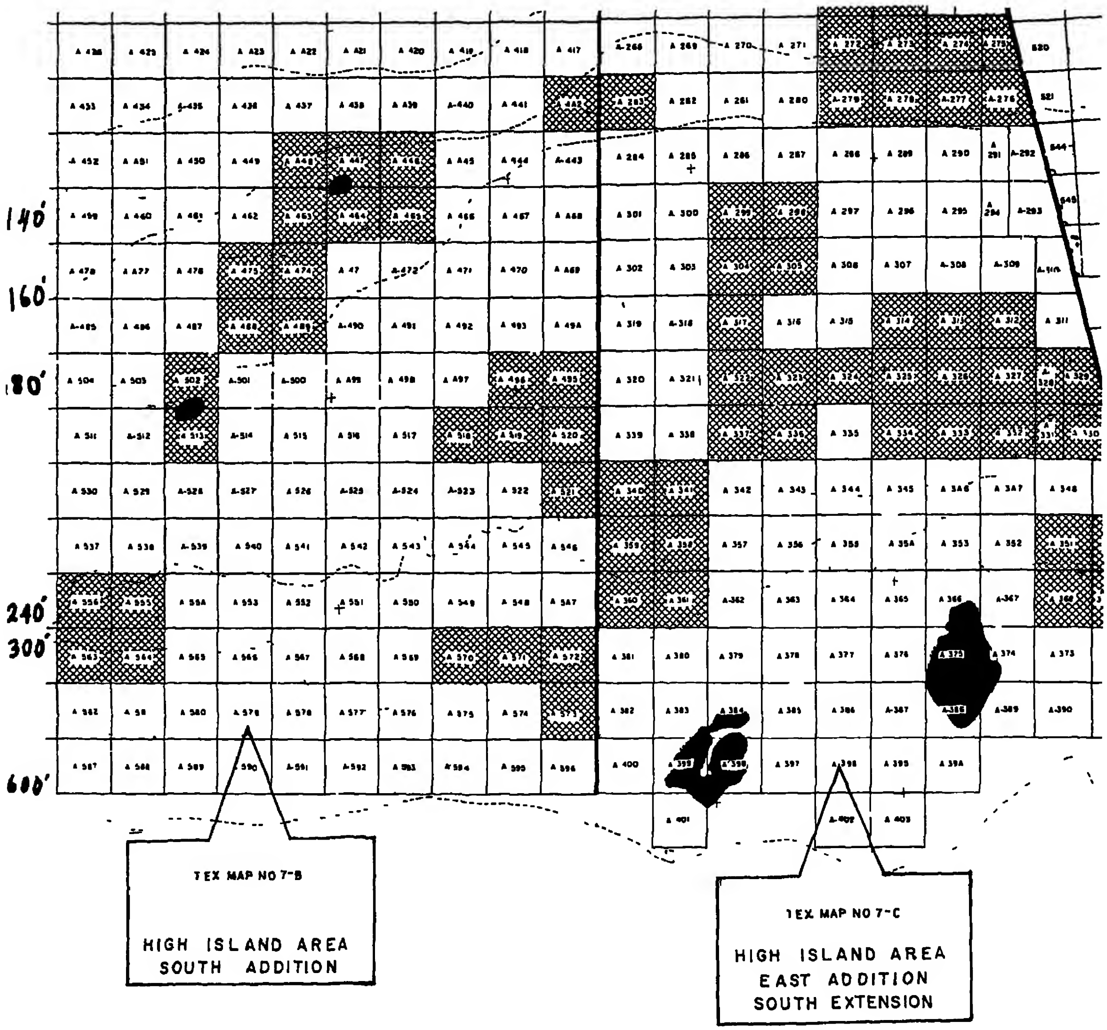

Figure 30. Relationship of Banks to Tracts Included in Proposed Lease Sale. (Orient to Leasing Plat inserted inside back cover.)

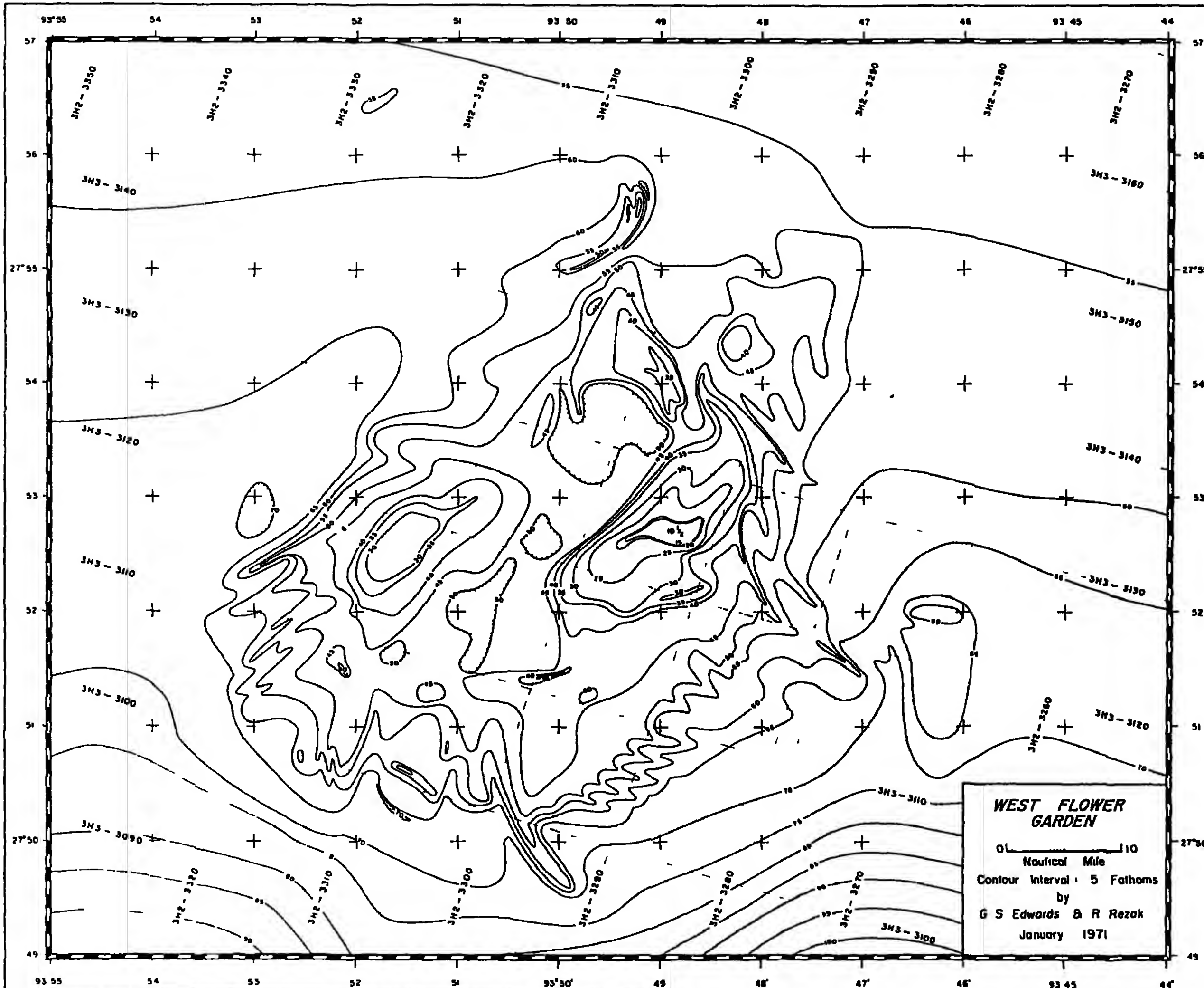

Figure 31. Bathymetric Chart of the West Flower Garden Bank. (from Edwards, 1971).

parameters controlling the lower limits to which the corals can grow, according to the same author, are the low temperatures, low levels of illumination and water turbulence (resulting in a mobile substratum) found on the 28 fathom terrace during the passage of storm fronts. The lack of a more diverse coral fauna on the bank is thought to be due to the length of time the planula stage takes to travel from the Veracruz and Yucatan reefs to the West Flower Garden Bank.

Dr. Thomas J. Bright 1/ presented the following description of reef community to the Department at the OCS Public Hearing in Houston, Texas, on February 21, 1973. 2/

> A thriving 100 acre tropical shallow water coral reef occupies the crest of the West Flower Garden hard-bank between 70 and 150 feet. The living corals grow in heads up to ten feet in diameter and height and cover 35 to 45 percent of the bottom, a relatively good cover for Atlantic coral reefs. The corals are dominant and structure the community which includes over 100 species of tropical reef fishes and over 200 species of invertebrates commonly found on Caribbean coral reefs.
>
> Downslope from the base of the coral reef, the bank is occupied by a rich community of algal nodules, soft algae, sponges, molluscs, worms, crustaceans, expatriate reef fishes, non-reef fishes, a variety of echinoderms and other invertebrates.

1/ Assistant Professor of Biological Oceanography, Texas A & M University, two years experience studying.

2/ The table on population levels for West Flower Garden fauna which follows the quoted material was presented by Dr. Bright at the Public Hearing in Houston.

Near 250 feet depth this community gives way to one occupying a soft sand-and-silt bottom. The transition zone between the two communities is marked by an abundant population of crinoids on the level bottom. Farther out, the soft bottom population consists mostly of burrowers and in some places seawhips, sponges and other surface forms.

Projecting out of the bottom in depths from 275 to at least 450 feet are old drowned (possibly Pleistocene) reefs occupied by a unique deep-reef community including calcareous algae (on the shallower drowned reefs) crinoids, brachiopods, echinoids, sponges, basket stars, solitary corals, fish and molluscs (including Entemnotrochus, whose shell is worth $300 to $400). Interestingly, the drowned reefs bear fan-like and whip-like octocorals, which as a group are absent from the shallower living reef. These fans and whips become more abundant with depth and in places the growth is lush in depths exceeding 400 feet.

We know less about the East Flower Garden [Fig. 3] but observations have shown that the living coral reef there is quite similar to that of the West Flower Garden, about the same size, and somewhat shallower at its crest (55 feet). The algal nodule community on the Bank below the East Flower Garden reef is likewise similar to that of the West Flower Garden.

Two other banks located within blocks to be leased have sparse and limited growths of living corals. These are Stetson Bank in blocks A-502 and A-513 and Claypile Bank 1/ in blocks A-447 and A464. Stetson Bank is noted for its profuse gastropod population and is, therefore, of some interest to shell collectors and malacologists.

1/ Since his presentation at the Houston OCS Public Hearing, Dr. Bright has determined that Claypile Bank has no living corals and apparently has a faunal assemblage indistinguishable from the surrounding Gulf floor (personal communication).

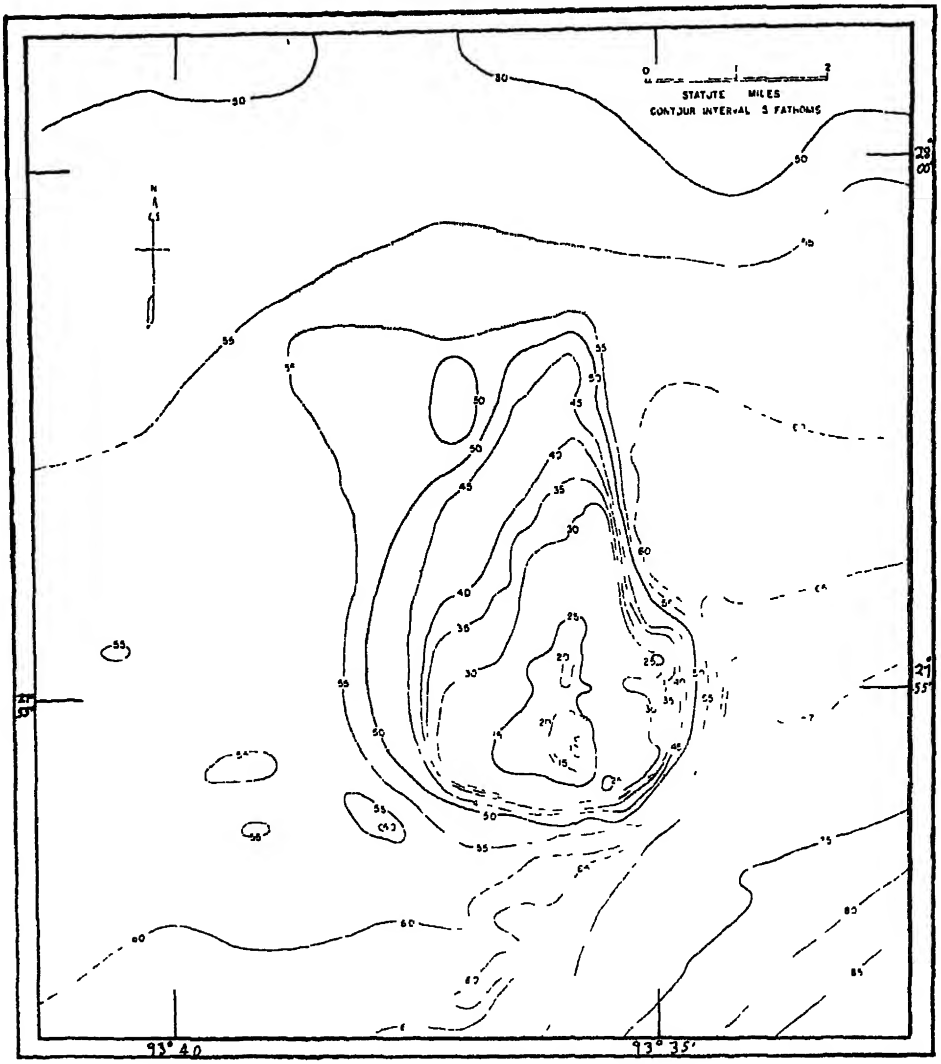

Figure 32. Bathymetric Chart of East Flower Garden Bank.
(from Parker and Curray, 1956).

West Flower Garden Reef Fauna

Population levels for certain conspicuous organisms on the 70 acres of West Flower Garden Coral reef above 100 feet depth. One chance in twenty that the population levels are greater or less than the upper and lower limits given.

	Lower Limit	Upper Limit
Corals	Percent	
Bottom covered by living coral	30.11	46.43
	Percent of Living Coral	
Montastrea annularis	18.64	34.12
Diploria strigosa	18.87	23.37
Montastrea cavernosa	3.49	10.05
Colpophyllia natans	1.64	8.60
Porites asteroides	1.26	6.82
	Number of Individuals	
Polychaete worms		
Spirobranchus giganteus	324,360	603,316
Echinoids		
Diadema antillarum	217,659	281,380
Gastropods		
All gastropods	412,048	568,127
Cerithium litteratum	194,389	318,969
Coralliophila abbreviata	95,917	176,227
Astraea tecta	60,019	107,694

Population levels cont.

	Lower Limit	Upper Limit
	Number of Individuals	
Pelecypods		
Lima sp.	9,786	39,286
Spondylus americanus	3,264	12,061
Crustaceans		
Paguridae (hermit crabs)	56,046	97,762
Sponges (none identified)		
All sponges	56,188	119,187
Red "A" sponge	9,932	25,824
Flat orange "k" sponge	8,371	20,006
Black Commercial "B" sponge	4,966	14,898
Yellow boring sponge	1,703	40,297
Small brittle orange "L" sponge	1,986	9,648
Purple "G" sponge	1,844	7,094
Brown encursting sponge	993	11,493
Fishes		
Thalassoma bifasciatum (Bluehead)	48,810	123,723
Pomacentridae (Damselfishes)	41,290	65,695
Chromis cyaneus (Blue Chromis)	19,297	33,202
Canthigaster rostrata (Sharpnose Pufferfish)	15,608	28,094
Paranthias furcifer (Creolefish)	9,933	30,364
Chaetodon sedentarius (Reef Butterfly fish)	9,507	20,006
Scaridae (Parrotfishes)	4,115	15,466
Bodianus pulchellus (Spotfin Hogfish)	1,986	9,081
Bodianus rufus (Spanish Hogfish)	993	8,939
Prognathodes aculeatus (Longsnout Butterfly fish)	426	4,966

3. The Oceanic Region - The Deep Gulf

a. Environment

Most of the Gulf of Mexico lies beyond the edge of the continental shelf, covering a surface area of about 500,000 square miles and achieving a maximum depth of about 15,000 feet. The open Gulf is characterized by clear water, low biological productivity and little variation in environmental conditions. The lighted (euphotic or epipelagic) zone extends to a depth of about 150 feet and is relatively warm (approaching 90° F. at the surface in mid-summer). The bottom water is completely dark and exhibits temperatures only a few degrees above freezing. This stratification is reflected in the distribution of biological and chemical components of the deep Gulf. All but seventeen of the tracts proposed for leasing are very close to the deep Gulf, ranging from 4 to 55 miles from the 100 fathom depth contour.

b. Life in the Oceanic Region

At the surface, light is the dominant factor in the epipelagic (euphotic) zone. The oustanding ecological feature here is that the animal consumers live in the same environment with the primary production by plants. Although the small endemic species of the epipelagic zone migrate little or not at all, there are many animals which invade the epipelagic zone from deeper layers during

the night or pass their early development stages in the photic zone. In either case, the abundant food supply is the primary factor.

A number of larger species in the oceanic, epipelagic zone are important to the sports and commercial fisheries. These include the mako shark (*Isurus oxyrinchus*), great white shark (*Carcharodon carcharias*), great barracuda (*Sphyraena barracuda*), wahoo (*Acanthocybium solandri*), the tuna and bonito (*Scombridae*), the sailfish and marlin (*Xiphiidae*), and a variety of reef fish.

Marine animals other than fish which might be observed infrequently in the northwestern Gulf include the gree and loggerhead turtles, long-snouted dolphin, atlantic killer whale, and pilot whale.

E. Resources of the Northwestern Gulf of Mexico and Adjacent Coastal Zone

1. Land Use Patterns and Resources of the Coastal Zone

a. Land use patterns

Figures 38 a-c, indicate the locations of the major urban areas in the Texas and Louisiana coastal zone shoreward of the sale area. The East Texas coastal zone is one of the most heavily urbanized areas of Texas and is supported by a wide resource base. Petroleum production and petroleum-related industry are the primary activities which support these urban centers. Other activities which have contributed significantly to urban development in the region are agri-business, shipping, tourism, and commercial fishing. Because of this urban development, the waters of the Texas coastal zone are subject to the problem of pollution from residential and industrial wastes and the problem of multiple-uses by shipping, fishing, and petroleum industry interests.

The coastal area of western Louisiana has very little urban development, being predominantly marshland. There are, however, numerous small towns and the important fishing port of Cameron on Calcasieu Pass.

SMSA 1/	Population (1970 U.S. Bur. of Census)
Houston metropolitan area	1,985,031
Beaumont-Port Arthur metro. area	315,943
Galveston-Texas City metro. area	169,812

1/ Standard Metropolitan Statistical Area.

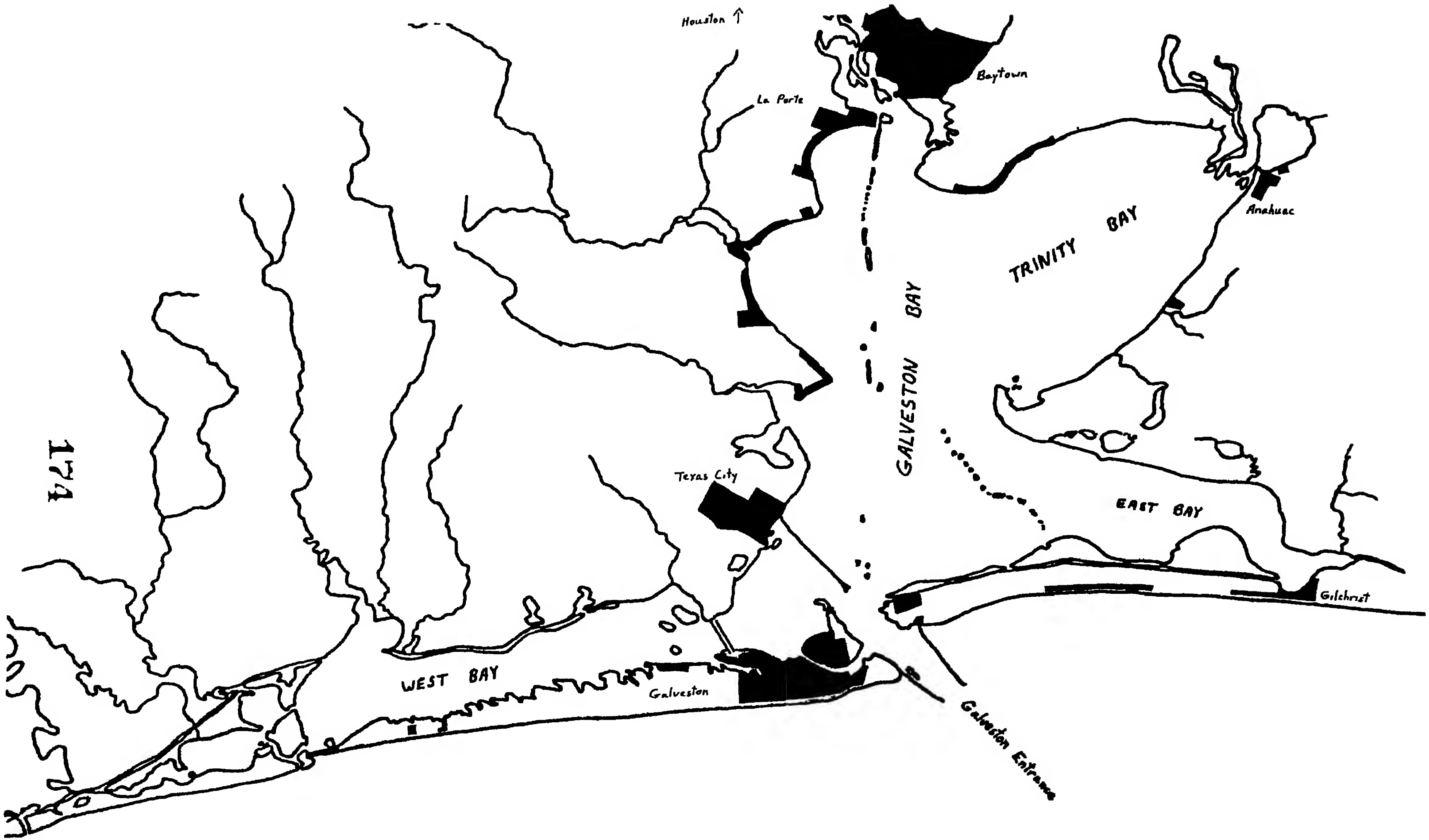

Figure 33,a.--Major Urban Areas of the Coastal Zone

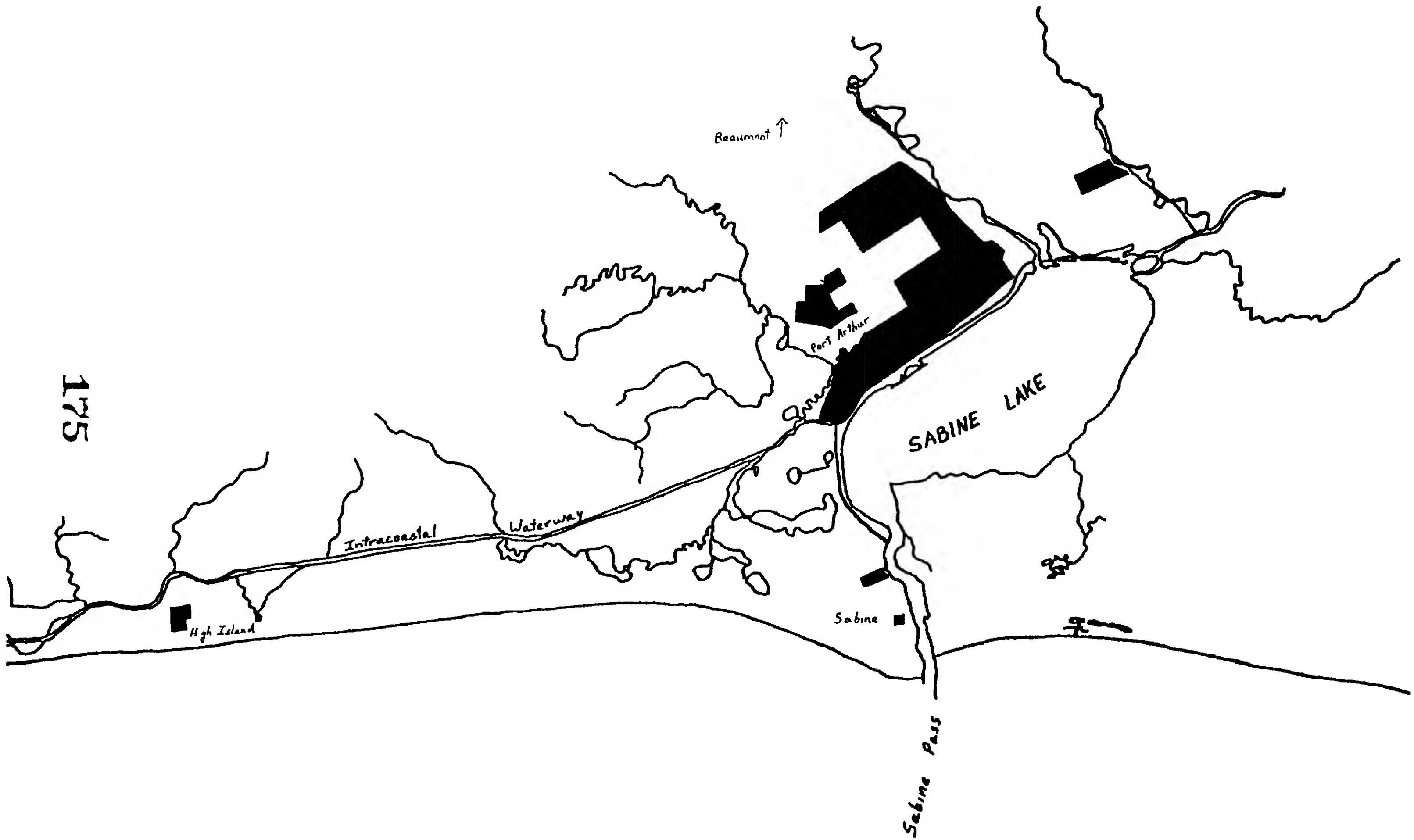

Figure 33,D.--Major Urban Areas of the Coastal Zone

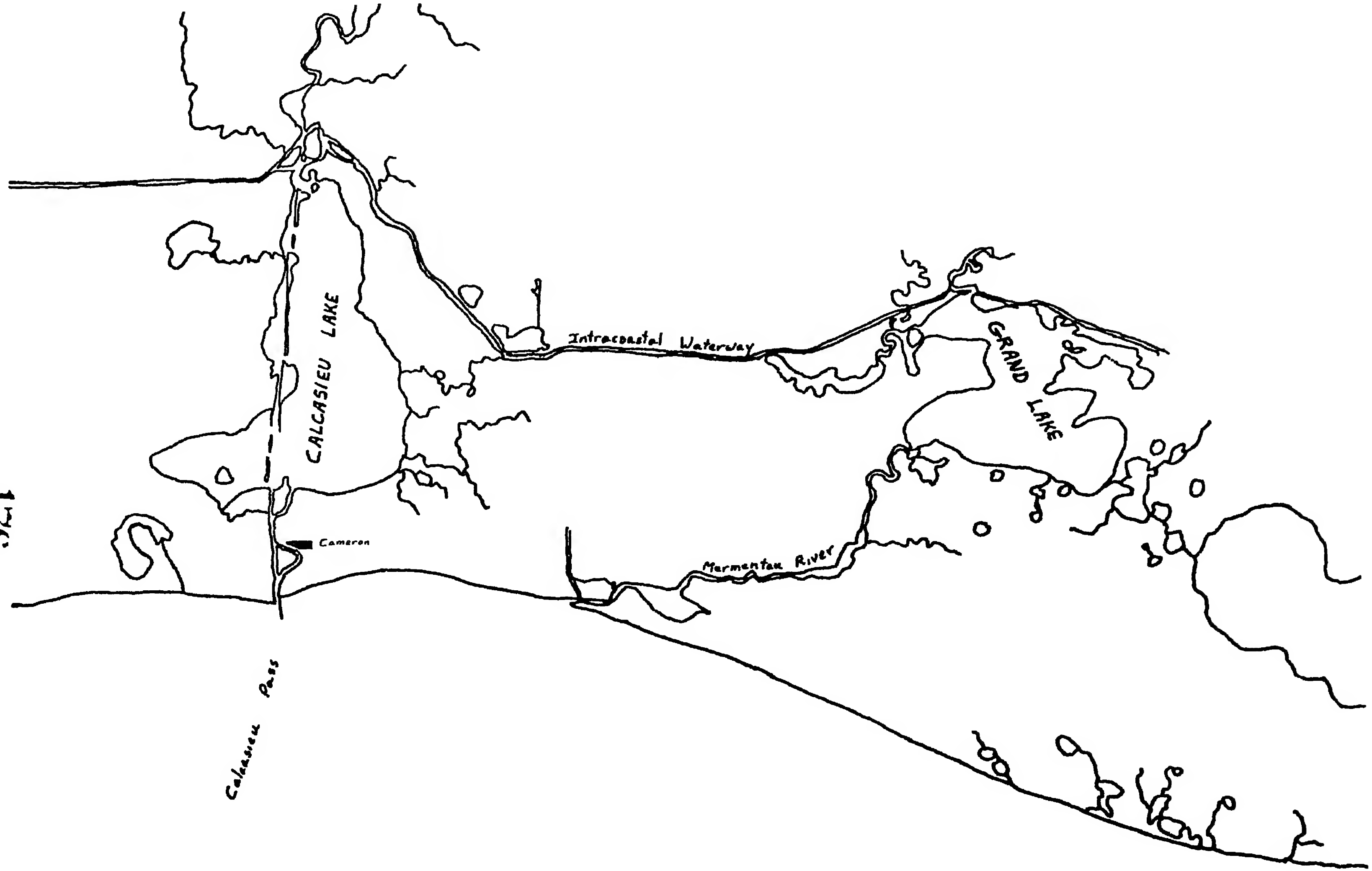

Figure 33,c. --Major Urban Areas of the Coastal Zone

Figures 34a-c, indicate generally the areas of agricultural and uncultivated land in the coastal zone shoreward of the sale area.

That land designated as agricultural is primarily uplands with relatively good drainage. The land may be under cultivation at present or temporarily out of cultivation. The principal crop grown in this area is rice but cotton, soybeans, and grain sorghums are also raised.

Land designated as uncultivated in Texas is used in a variety of ways. Much of this land, including some of the higher marshes and barrier strand plain vegetated flats, is used for grazing cattle. Other uses include wildlife refuges, urban development, both residential and industrial, and recreation areas.

In western Louisiana, the variety of land use is limited by the marshland environment. The primary uses of this coastal marsh are oil and gas production, recreation (hunting and fishing), wildlife management, and cattle grazing. Much of the area is accessible only by boat or special conveyance and is unfit for cultivation.

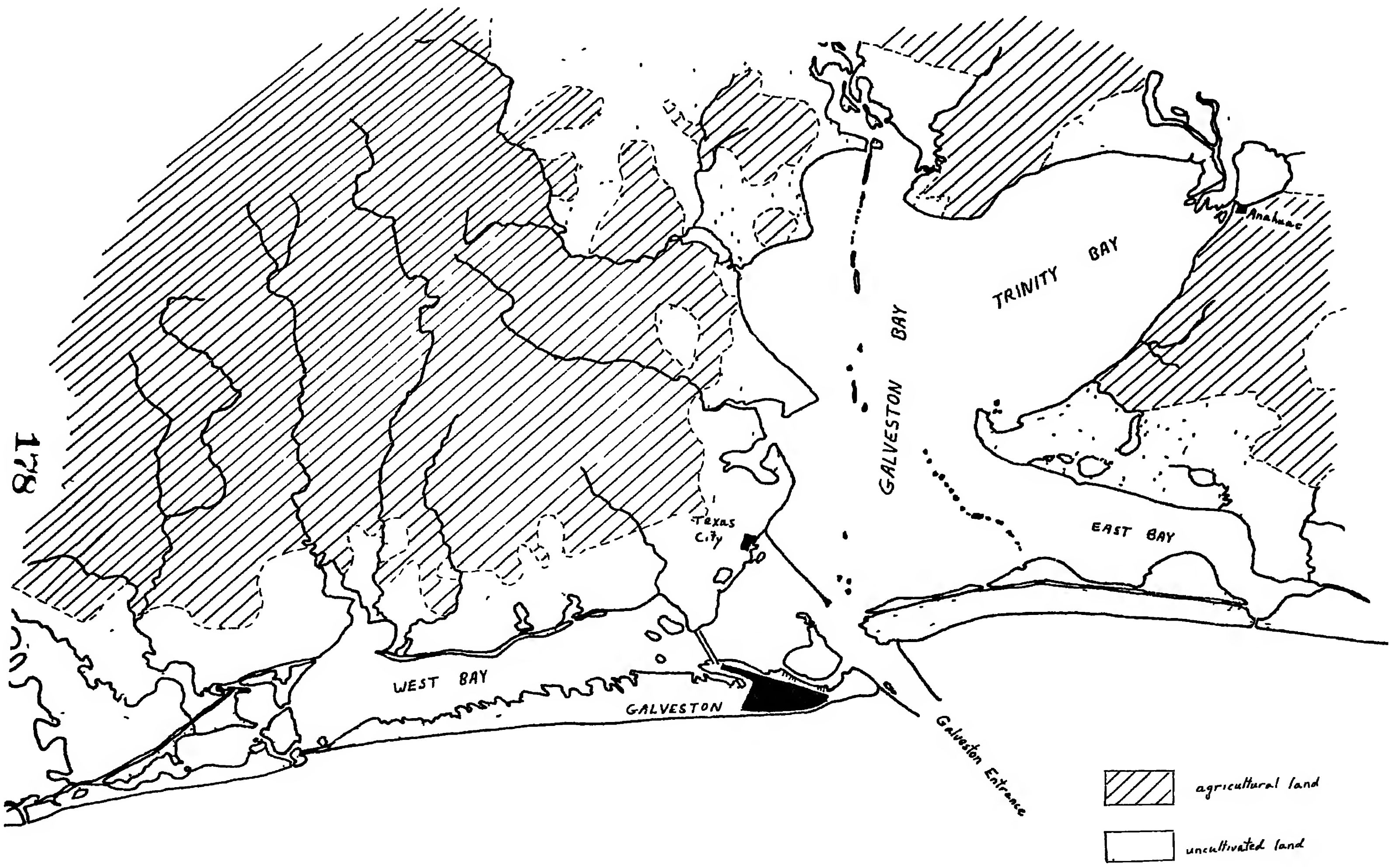

Figure 34,a.--Agricultural and Uncultivated Land of the Coastal Zone

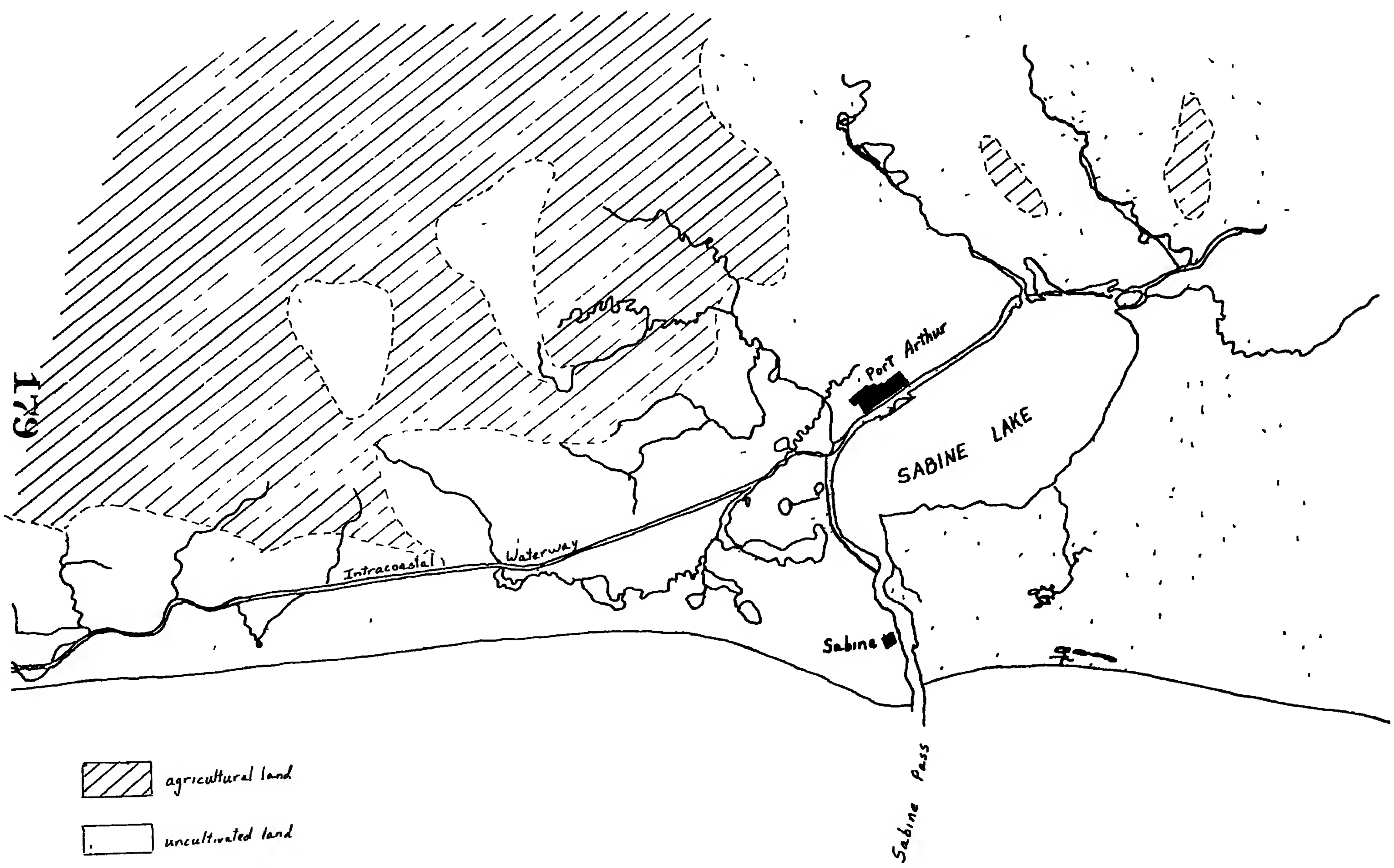

Figure 34,b.--Agricultural and Uncultivated Land of the Coastal Zone

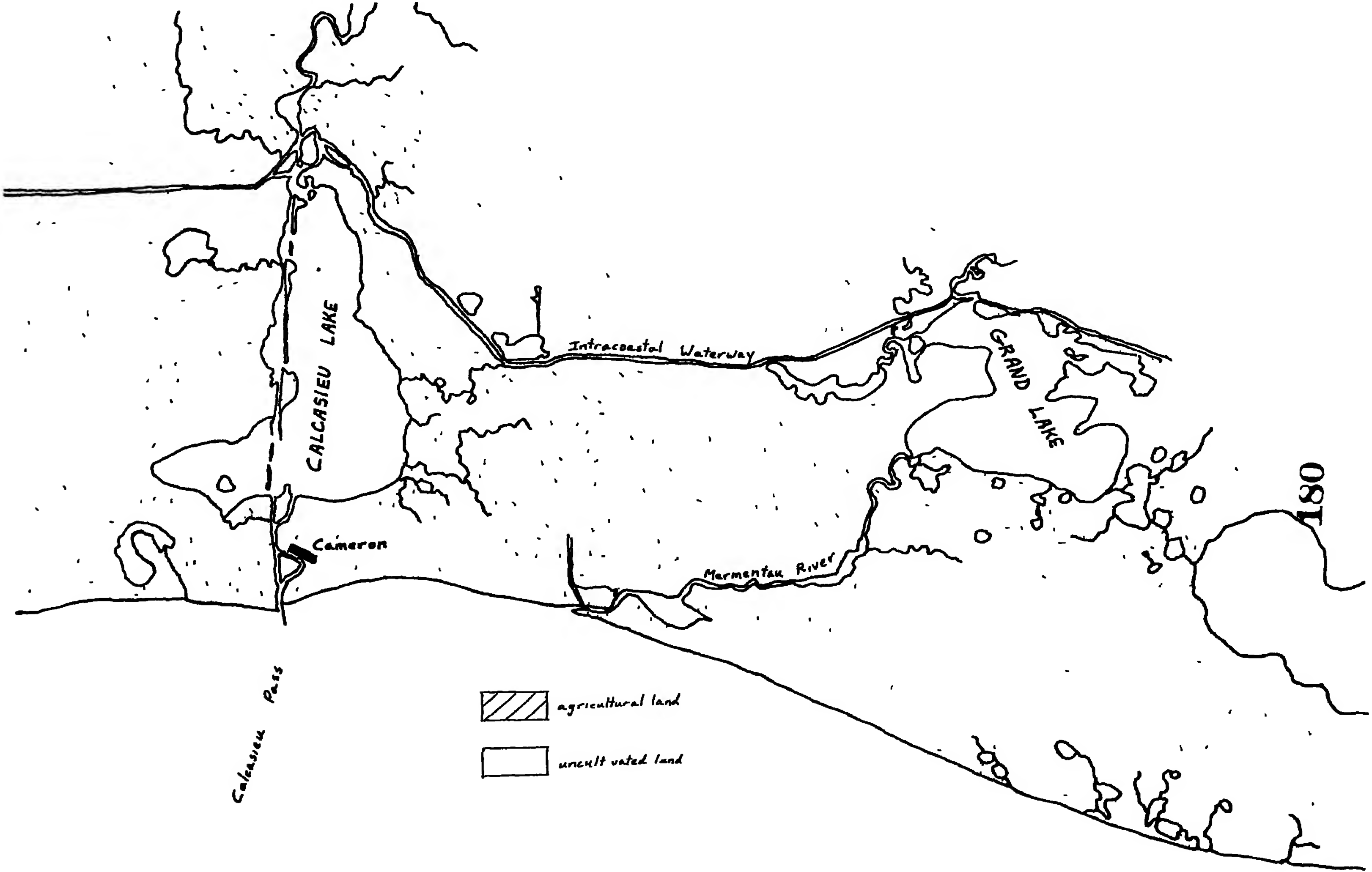

Figure 34,c.--Agricultural and Uncultivated Land of the Coastal Zone

Figures 35 a-c, indicate wildlife refuges or management areas and state-owned beaches used as public recreation areas. Although wildlife refuges were not created primarily for recreational purposes, they do offer opportunities for some types of recreation such as bird watching, nature study, hiking, etc. Although not shown on the map, there are numerous county and city-owned parks in or near the urban areas.

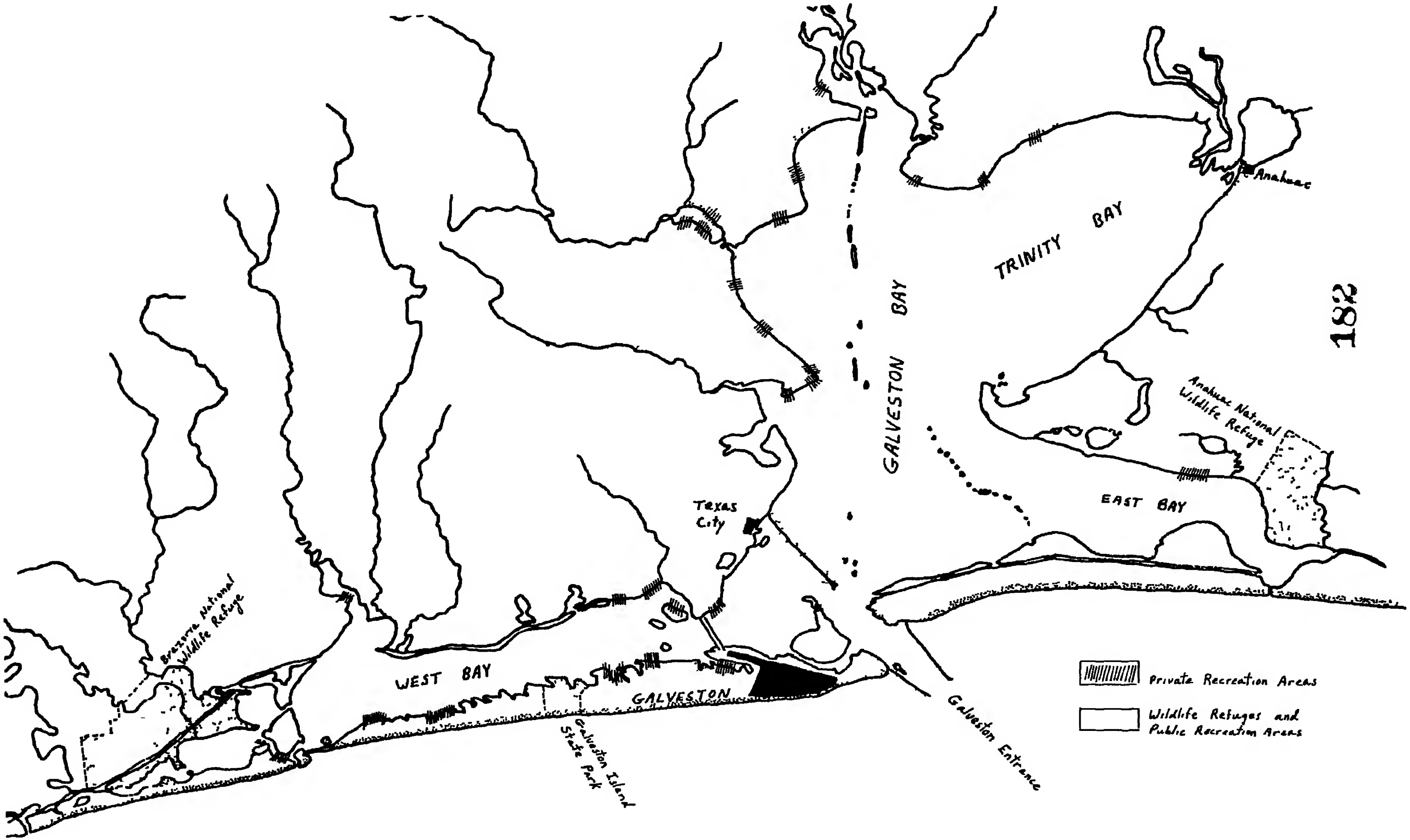

Figure 35,a.--Wildlife Refuges and Public Recreation Areas of the Coastal Zone

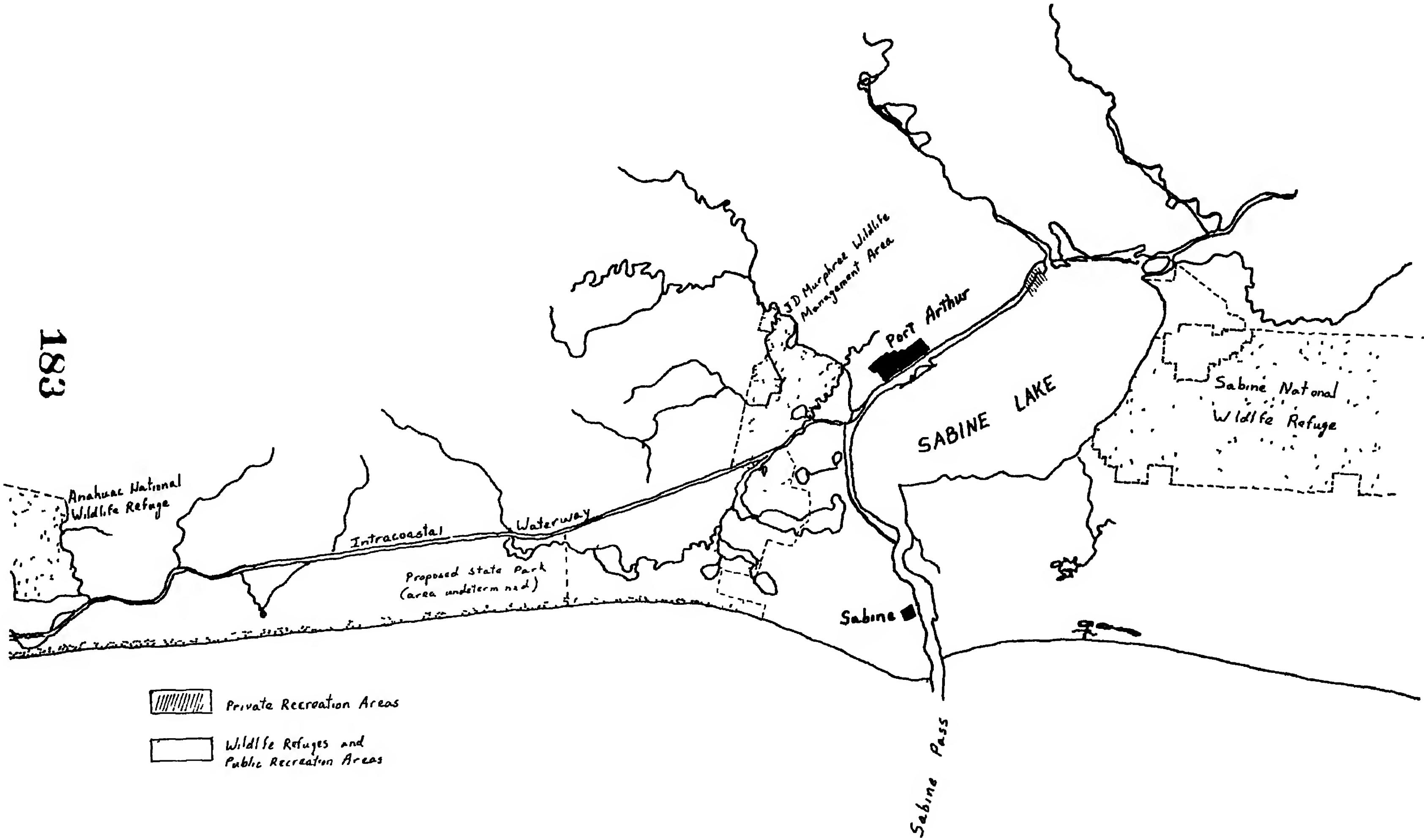

Figure 35,b.--Wildlife Refuges and Public Recreation Areas of the Coastal Zone

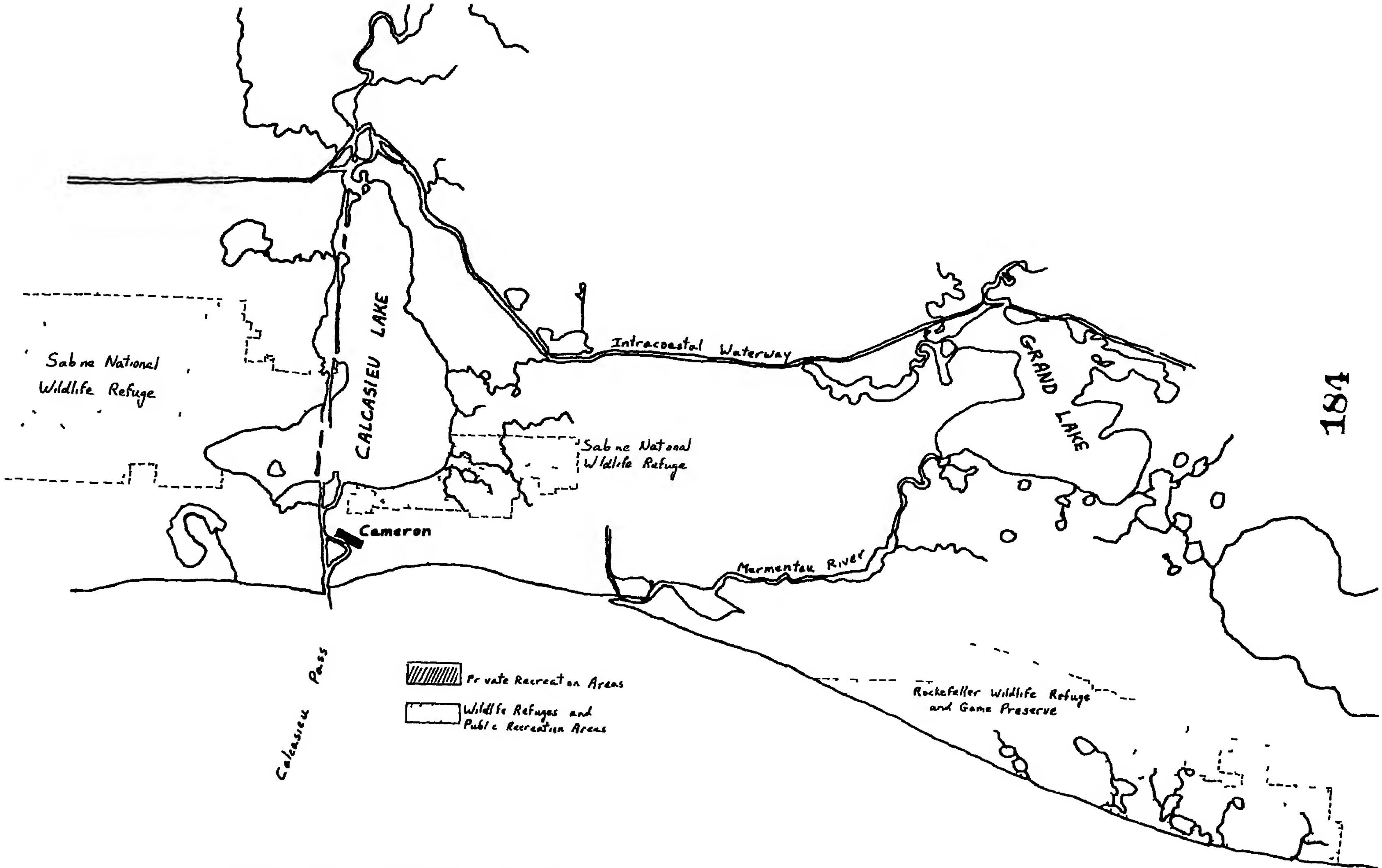

Figure 35,c.--Wildlife Refuges and Public Recreation Areas of the Coastal Zone

b. Land Ownership

The greatest portion of land in the coastal zone is privately owned, but there are substantial amounts of State and Federally owned land in the area also. State-owned areas in the coastal zone include submerged lands, riverbed acreage, state prison lands, public school and university campuses, state parks, and wildlife refuges. Submerged lands comprise the greatest part of State-owned land in the coastal zone. The State of Texas owns submerged lands along the coast out to a distance of 3 leagues (10.36 miles) from shore as well as submerged lands beneath the bays and lagoons. The boundary in Texas between State-owned submerged lands and privately-owned uplands is the line of mean higher high water (Campbell, 1961). The State of Louisiana owns coastal submerged lands out to a distance of 3 miles from shore, and the boundary between uplands property and state-owned submerged lands is the line of highest water during the winter season (Campbell, 1961).

Federally-owned land in the coastal zone consists primarily of wildlife refuges, Corps of Engineers facilities, and military reservations.

c. Cultural Resources

(i) Recreation Resources

Louisiana and Texas both possess quality water-oriented resources which support substantial outdoor recreation activity. However, there are significant differences in the physical characteristics of the coastal areas of the two states that determine the type of recreation opportunities that each state can offer.

The coastal zone of Louisiana is characterized by a narrow fringe of low, flat, sandy beaches backed by vast marshlands that extend many miles inland. Access to many areas of the marsh is possible only by boat on the many canals and bayous. The climate is suited for outdoor recreation the year round but fall and spring are the most pleasant. The principal weather problems, thunderstorms and hurricanes, can be dangerous due to the flat, featureless terrain which provides little shelter from high winds and storm tides. Most of the Louisiana coast is undeveloped. Hunting, fishing, boating, and wildlife observation are the types of recreation best suited to the area, and several areas of the coastal marsh have been set aside as wildlife refuges.

The Texas coast is entirely a sandy barrier beach except for an area of marsh and mudflats immediately west of Sabine Pass. Much of the coastal barrier beach is backed by marsh and lagoons or bays. There are few areas which provide shelter for boats other than the bay entrances or interiors. The climate of the area is suitable all year for outdoor recreation. Much of the Gulf beach area is undeveloped, however, there is summer residential and commercial development on Galveston Island, Follets Island and Bolivar Peninsula. The bay shores are somewhat more developed, primarily for private purposes (Campbell, 1961).

The Texas coastal area is suited for recreational activities similar to those in Louisiana, (fishing, boating, wildlife observation) but is better suited for swimming than is the Louisiana coast. Air and water pollution problems near the large cities may detract from their attraction as outdoor recreation areas.

1. Federal Areas

The major Federal holdings in the coastal areas of East Texas and western Louisiana are the following wildlife refuges: Anahuac and Brazoria National Wildlife Refuge in Texas; and Sabine National Wildlife Refuge in

Louisiana. While the purpose of the refuges is to provide migratory waterfowl habitat, they also provide habitat for many other wildlife species as well as significant opportunities for recreation.

2. State Areas

State owned areas in coastal Texas and Louisiana which are available for recreation include wildlife management areas, historic monuments, state parks, and public beaches. The state owned wildlife refuges shoreward of the sale area include Rockefeller Wildlife Refuge and Game Preserve in Louisiana, and the J. D. Murphree State Wildlife Management Area in Texas. State parks include Galveston Island State Park (temporarily closed for development) a proposed state park in Jefferson County, and Velasco State Park which is the area between low and high tide on the Brazoria County, Texas shoreline. Federal, state, and private recreation and wildlife areas are summarized by acreage in Attachment D.

(ii) Historical and Archeological Resources

The National Register of Historic Places was consulted and it was found that there are no historical sites listed within the proposed lease sale area. Also, none of the sites chosen for submission to the National Register by the Texas State Board of Review (Briggs, 1971) are within the proposed sale area.

There are however, numerous historical and archeological sites along the Texas coast, shoreward of the sale area. Archeological sites contained in the Texas coastal lowlands and littoral area represent all known stages of aboriginal cultural development, and there are numerous historic sites, such as towns, forts, houses, missions and ship wrecks.

According to a report prepared for the U.S. Army Corps of Engineers by the Texas Archeological Salvage Project, (U.S. Army, 1972) ten percent of the land area within one mile of the shoreline and less than one percent of the water-covered area within the 3-league line have been systematically searched for archeological and historical sites. Thoroughness of coverage ranged from 50-80%, and sites were found to occur in densities up to four per square mile. Between Sabine Lake and Corpus Christi Bay the most common type of site found is the shell midden. These range in size from

small deposits representing a few days occupation, to large mounds indicating periodic occupation over hundreds of years. Of 717 sites documented over the last four decades, at least one third have been destroyed by erosion.

Virtually all navigable coastal waters of Texas except some of the more shallow bays such as Aransas Bay may be expected to contain sunken vessels of some historical interest. These vessels were probably involved in travel along the Texas coast. Wrecks of vessels involved in longer range activities, such as Spanish vessels of the 16th centry, may be found offshore, most likely within 1/2 mile of the shoreline. A list of pre-20th century ship wrecks on the Texas coast, compiled by the Office of the State Archeologist, Texas Historical Survey Committee, (Briggs, 1971) indicates that there are at least eleven such ship wrecks on the coast shoreward of the sale area.

It is possible that more sites of cultural significance remain to be discovered within and nearby the sale area. There is a lack of knowledge concerning the locations and kinds of historic and archeological sites especially on the Outer Continental Shelf. Surveys are needed, especially in areas of potential oil and gas leasing, to locate and evaluate these resources before an accurate assessment can be made of the impacts of OCS oil and gas operations on resources of this kind.

In an effort to obtain a more complete knowledge of resources of historic and archeological value in the area and to respond meaningfully to Executive Order 11593 (Protection and Enhancement of the Cultural Environment), the Bureau's New Orleans-based Environmental Assessment Team is undertaking to locate, describe, and inventory existing archeological and historic sites on the OCS and in onshore areas, and State waters that might be affected by OCS activities.

Until such thorough surveys can be made, a means is needed to provide for the protection of these resources, Therefore, in order to identify and protect resources of historical, archeological, and architectural significance, and to comply with Section 2(b) of Executive Order 11593, a stipulation has been developed by the Department for possible inclusion in leases issued as a result of this proposed sale. This stipulation is presented in section IV.D.1 of this statement.

d. Wildlife Resources

(i) Birds

The proposed sale area lies between two major migratory routes of birds: the Mississippi flyway to the east and the Central flyway to the west. Consequently, the greatest variety of birds is found during migration, in the spring and again in the fall.

In addition to the geographic location, this section of coastline offers a wide variety in bird habitat. The long expanses of mud flats and beaches are inhabited by shorebirds, the shallow bays and wetlands offer habitat for wading birds, and the savannah and prairie offer suitable habitat for a great number and variety of birds.

(a) Waterfowl

Nearly all waterfowl known to occur along the northwestern Gulf coast spend the warmer parts of the year nesting and feeding in the far north and migrate down the Central or Mississippi Flyway to the Gulf coast after the onset of shorter days and cold weather. These birds may become extremely numerous during the peak of migration.

Most geese spend the winter in the coastal lagoons and marshes, grubbing for submerged aquatic vegetation. Canada geese and to some extent, blue geese, have learned to utilize

grainfields for food and may also spend time inland on fresh water.

The surface feeding ducks (or dabbling ducks, including the mallards, pintails, black and wood duck, teals, gadwalls, shovelers) exhibit a wide variety of feeding and resting habits. Several have adapted to farm ponds and grain fields, but others remain completely dependent on the coastal salt marshes for the winter home, dwelling there and feeding on aquatic insects, mollusks, marine plants, and marsh grass.

Of the diving ducks, only redheads, coots, canvas backs, and scaups spend much time on inland waters and in grain fields. The rest (buffleheads, hooded mergansers, goldeneyes, old-squaws, scoters, and eiders) pass the winter either in coastal lagoons, bays, tidal lakes, or as pelagic birds far out into the open Gulf.

(b) Shorebirds

This is a diverse and highly mobile order (Sprunt, 1967). They are able to exploit a variety of habitats in the coastal prairies, Gulf Coast marshlands and estuaries, seaward beaches, and less frequently, inland waters.

All but a few are dependent however, on wetland situations for most of the year. Even species that perform spectacular over-water migrations, such as the golden plover, must have the marshes and mud flats of the western Gulf coast for their return flight in spring. Plovers, small to medium-sized shorebirds, spend summers in the Arctic and winters in South America, stopping over in spring in pastures and mud flats along the Gulf coast. Sandpipers include both shore and wading birds, but most are seen along the ocean shores where they feed on small invertebrates. Avocets, medium to large slender-legged waders and phalaropes, including upland, shore, and pelagic species, are also present in the Gulf area.

(c) Large Fish-Eating Birds

A 1969 census from the region between the Sabine River and Matagorda City exceeded 45,600 of these birds. 1/ In order of decreasing occurrence, these long-legged waders included the cattle egret, white-faced ibis, white Ibis, snowy Egret, Roseate Spoonbill, Common Egret, Louisiana Heron, Lesser Blue Heron, Black--Crowned Night Heron, White Pelican, Great Blue Heron, Olivaceous Cormorant, Reddish Egret, Green Heron, Yellow-crowned Night Heron, Anhinga, and Least Bittern.

1/ Hildebrand, H. and G. Blacklock, 1969. The 1969 cooperative census of fish-eating birds along the Texas coast from the Sabine River to the Rio Grande. Unpublished report.

Lacking entirely in this region is the rare and endangered brown pelican. The egrets and herons are long-legged wading birds that may remain in their Gulf coast habitat the year round, feeding on fish and other small marine life. Cattle egrets feed largely on insects. The spoonbill and ibis family tolerates a wide range of salinities and local habitats but usually is restricted to the shallow bays, estuaries, lagoons, and marshes, along the Gulf coast. The white-faced ibis may migrate inland for summer nesting. The white pelican is locally common in breeding colonies along the Gulf coast in winter, and fishes by wading in shallow waters, often in flocks, scooping up fish with its large bill. Cormorants and anhinga are fish eaters that dine from the surface and swim underwater. The Double-crested cormorant migrates northward in summer.

(d) Other Birds

Colonial birds, such as gulls and terns, use the offshore barrier islands extensively for nesting and feeding. Large populations of rails and gallinules nest in the marshes during the summer. Snipe are present in large numbers during the winter. Scattered pairs of bald eagle and osprey may be found nesting along the Louisiana-Texas coast.

(ii) Mammals

Noteworthy mammals living in the coastal zone and depending largely on the swamp and salt marsh communities for food include the armadillo, bobcat, deer, gray fox, mink, muskrat, nutria, opossum, river otter, eastern and swamp cottontails, raccoon, striped skunk, and red wolf.

The river otter and red wolf seem to be facing extinction from this region. Deer and rabbit are taken by hunters. Mink, muskrat, nutria, raccoon and opossum populations are utilized extensively by fur trappers.

(iii) Other Wildlife

Reptiles along the coast include the alligator, (included on the official list of rare and endangered species along with the whooping crane, brown pelican, peregrine falcon, and red wolf, all from within or near the coastal area of interest)[1/], diamondback rattlesnakes, and numerous other snakes and lizards.

(iv) Wildlife Refuges

In order to provide sanctuary for migratory birds and other fauna of the area, a number of wildlife

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1/ At least in western coastal Louisiana, the alligator is doing quite well. The State of Louisiana was able to open a limited hunting season for alligator in Cameron Parish in 1972.

refuges, and management areas have been established. (Federal, State, and private recreation and wildlife areas are summarized by acreage in Attachment D). Because of its location in relation to the Central and Mississippi Flyways and the wide variety of habitat the area offers for birds, the refuge areas are managed primarily for migratory and wintering waterfowl.

2. Commercial Fisheries of the Northwestern Gulf of Mexico

a. Important Commercial Species and Their Generalized Biology

The National Marine Fisheries Service lists the following species of fish and shellfish in their statistical publications as contributing to the commercial catches in the western Louisiana, Sabine, and Galveston Districts (Table A). The value of each species catch is impossible to include here, based on the information made available to us. The total worth of the commercial catch to each state, which includes some freshwater species, and many salt water species and catches made and sold outside of the proposed sale area was, $72,630,000 for Louisiana and $70,037,000 for Texas (National Marine Fisheries Service, 1972).

From the catch weights in Table A, it can be seen that croakers, drums flounders, king whiting, menhaden, red snapper, seatrout, sheepshead, blue crabs, shrimp and oysters composed the bulk of the catch.

The distribution and life history of these fish and shellfish and others of the Texas/Louisiana coastal zone vary between species but general groupings, with some overlap, can be identified. On the basis of these characteristics, fishery species are classed as resident, semi-catadromous, or seasonal migrant. (These terms are defined in the following sections.)

Table A

Commercial Fisheries Landings for 1971 in Louisiana and Texas

Recent Trends 1/
(+) increase (-) decline (*) no change

Species	Louisiana Pounds		Texas Pounds	
Fish				
Bluefish	35			
Cabio	3,577		14,350	
Croaker	294,342	+	52,220	+
Drum, Black	505,680	+	1,130,370	-
Drum, Red (Redfish)	723,642	+	2,003,799	+
Flounders (Unclassified)	463,150	+	338,728	+
Groupers	2,924	-	134,623	*
Jewfish	2,403		----	
King Whiting (kingfish)	431,051	*	80,157	*
Menhaden	1,229,493,000	+	----	-
Mullet	8,193	*	99,035	*
Pompano	19,244		3,200	
Sawfish	200		----	
Sea Catfish	65,193		46,536	
Sea Trout, Spotted	1,122,042	+	1,480,568	*
Sea Trout, White	131,561		2,221	
Sharks (Unclassified)	905		----	
Sheepshead, Saltwater	239,124	+	132,006	+
Snapper, Red	161,683	-	1,047,730	*
Spanish Mackerel	39,645		----	
Spot	18,375		----	
Tripletail	7,575		----	
Unclassified	1,760		62,924,534	
Shellfish				
Crabs, Blue	10,945,109	*	5,828,650	+
Shrimp, (heads-on)	92,612,883	*	84,883,769	*
Oyster (Meats)	9,757,737	*	4,702,852	+
Squid	3,078		11,884	

1/ Approximately 1950-71. Dated used is from U.S. Dept. of Interior, 1967, 1968, 1969; U.S. Dept. of Commerce, 1971, 1972a, b.

1. Resident Species

Resident species complete their life cycle in estuaries and are dependent on this zone most of the time. Oysters, blue crabs and spotted seatrout are classed as resident species although blue crabs and spotted seatrouts may for a short time, venture into the shallow coastal waters. All three species contribute significantly to the commercial fishery, and spotted seatrout and blue crab are also sought by recreation fishermen.

Since the advent of offshore oil and gas activities, other resident species of the continental shelf have become concentrated around drilling structures. Among these are: red snapper, groupers, trigger fish, spade fish, giant sea bass, pompano, and many smaller species. Speculation that these species and other larger, seasonal game fish, such as sailfish and marlin, have appeared only since the offshore oil industry became active is erroneous. However, the platforms do create artificial environments which attract and concentrate many predatory species.

2. Semi-Catadromous

Semi-catadromous species spawn in the Gulf of Mexico, the young migrate to their estuarine nursery area, where they grow to sub-adults; then they return to the ocean where their life cycle is completed. Some species may return to the estuaries for short

periods as adults. Major species include white shrimp, brown shrimp, menhaden, Atlantic croaker, spot, black drum, red drum, sand seatrout, southern flounder, and saltwater sheepshead. As noted above, these species contribute significantly to the commercial fishery, and, except for menhaden, are also caught in great numbers by sport fishermen.

3. Seasonal Migrant Species

The seasonal migrants generally reside in the nearshore waters of the continental shelf during the summer season, and some may forage briefly in the estuaries. They appear in late spring as the waters warm and depart as the water temperature declines in the fall. They either winter in the warmer offshore waters of the Gulf of Mexico or migrate to warmer coastal waters off Mexico or southern Florida. Some spend considerable time in the vicinity of the oil and gas platforms. Major species are the spanish and king mackerel, tarpon, ladyfish and several species of jack, bluefish and cobia. Several of these, in other areas of the Gulf, are semi-catadromous. Other species found in the offshore waters include marlin, sailfish, wahoo, and a variety of tuna, sharks, skates and rays. At this time, none are important as major commercial species in Texas and Louisiana, but most are sought by recreation fishermen.

b. An Overview of the Fisheries

Thompson and Arnold (1971) give the following account of Gulf fisheries:

"Since the days of the aborigines the Gulf of Mexico has been a source of seafood for Americans. The abundance of fish and shellfish in innumerable bays, sounds, and lagoons along the coast provided pioneer settlers with their own needs and also were a basis for trade with inland colonists. By the mid-1850's, commercial fishing was fairly well established, but still was conducted almost entirely in inshore waters or within a few miles of the coast, except for the offshore red snapper fishery.

"According to the first statistical survey in 1880, the Gulf fisheries of the United States yielded 23.6 million pounds, valued at $1.2 million. (By 1888, Gulf fisheries included oysters, red snappers, mullet, seatrout, red drum, sheepshead, shrimp, blue crab, sponges, and turtles.)

"The Gulf fisheries have been in a period of accelerated expansion since 1940. This is quite different from the fisheries in other regions, which are mainly static or declining. The marked increase in quantity and value of

Gulf fishery products during the last quarter of a century was primarily due to expansion in the shrimp and menhaden fisheries. Blue crab catches also increased substantially. A new fishery was started in 1952 to supply a variety of small trawl-caught bottom fishes--previously unutilized--for manufacture into pet food. Catches of other species, of which there are 50 to 60, were maintained with relatively minor deviations around their long-term average."

The shrimp fishery and industrial bottom fishery grew by expanding the fishing grounds. "The industrial fishery for the pelagic menhaden expanded production by intensifying its harvest of the resource on traditional grounds. These are in shallow coastal waters off Mississippi and Louisiana and one small area off western Florida. Menhaden fishing along most of Texas and all of Alabama normally is prohibited by State law... The fishing grounds for other species of fish in the gulf have remained unchanged through the years. The snapper and grouper grounds are the same today as they were before the turn of the 20th century. Sea-trout, mullet, drum, and other estuarine-dependent

species are caught in bays, passes, and along the beaches as they always have been...Similarly, the fishing grounds for shellfish (other than shrimp) have changed little."

Major fishing grounds and banks in the vicinity of the proposed sale area are shown in figure 36. The spacing between symbols shows the relative intensity with which the species are fished. The map is a composite of smaller maps and verbal descriptions, and hence, probably contains gaps and inaccuracies. Also, no information could be found for fishing grounds for many of the commercial species listed in Table A. Sources of information used to construct the map include the Texas Offshore Fishing Chart (Tidewater Fishing Publications, Inc.; Seabrook, Texas); Gulf of Mexico Shrimp Atlas (Osborn, Maghan, and Drummond, 1969), and Gulf of Mexico Fisheries (Thompson and Arnold, 1971).

Historical statistical data show that total catches for many popular Gulf species have maintained reasonably constant levels in recent years despite growing fishing efforts indicating that fisheries in the shallow, nearshore waters may be approaching maximum sustained yield. While it is true that some of the less popular and under-utilized species, such as mullet, have a significant potential for

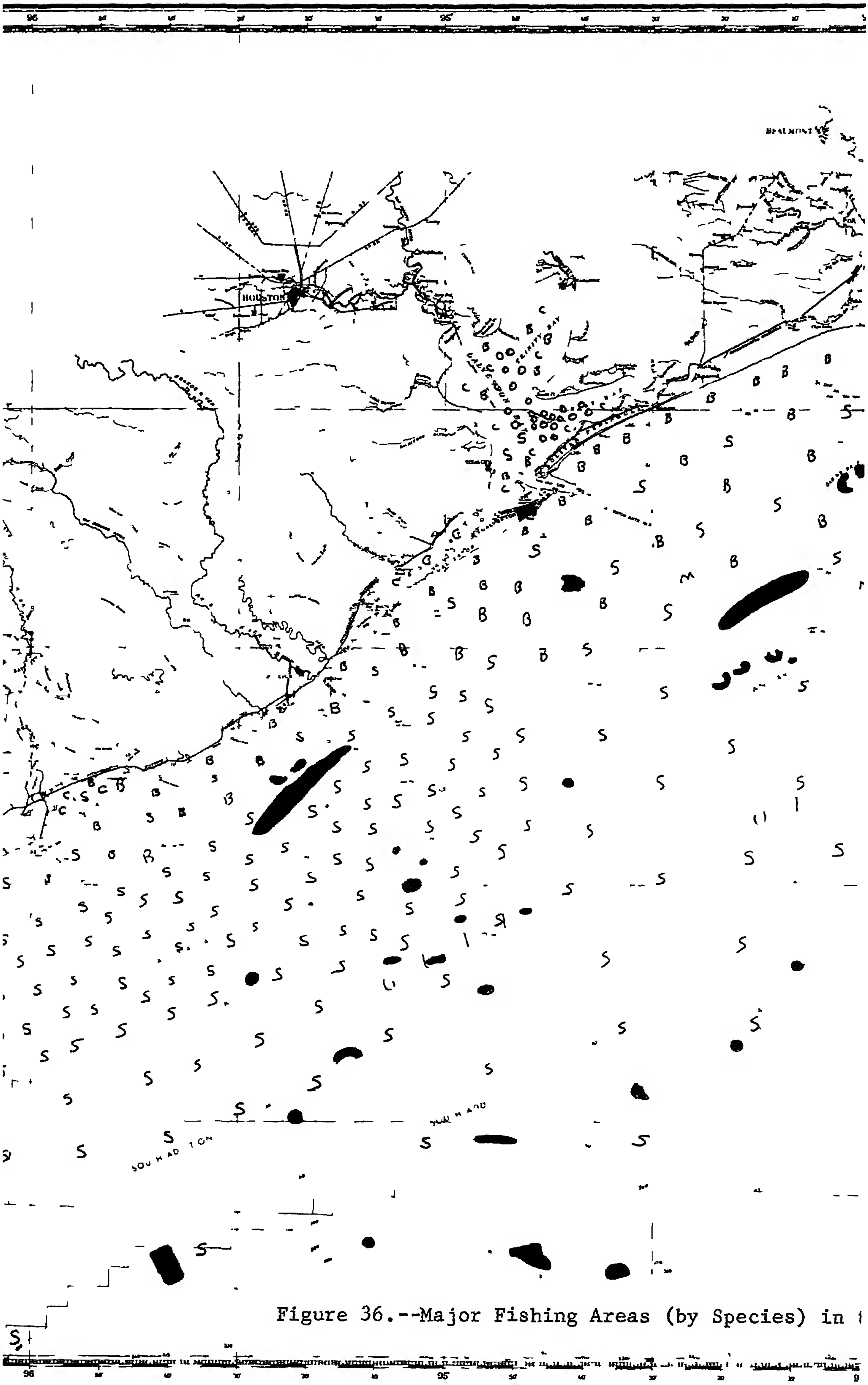

Figure 36.--Major Fishing Areas (by Species) in

In 1965, an estimated 738,000 anglers caught 89,550,000 fish weighing 93,809 tons. The survey also reveals that about 2/3 of the anglers fished in the rivers and bays rather than offshore, although the pounds of fish caught was about equal for both categories. Twenty-five species were listed as having made up almost the entire sports catch. In decreasing order of poundage caught, they were: spotted seatrout, snapper, sand seatrout, black drum, red drum, croaker, king mackerel, white perch, grouper, summer flounder, kingfish, dogfish shark, bluefish, porgy, catfish, mullet, shark, spanish mackerel, pompano, jack, cobia, barracuda, grunt, dolphin, and atlantic spadefish, and miscellaneous other fishes.

The biology of many of these species is discussed in the preceeding section on commercial fishing.

4. Oil and Gas Resources

As of September 30, 1972, there were 5,774 wells with 9,457 completions capable of producing oil and gas in the OCS of the Gulf of Mexico. Of these, 111 wells with 159 completions are found in the OCS offshore Texas. Oil and gas production from the OCS leases offshore Texas during 1971 accounted for 1.7 million barrels of oil and 127 billion cubic feet of gas with a market value of $26.3 million. Oil and gas production in 1971 from the OCS leases in the Gulf of Mexico accounted for approximately 387 million barrels of oil and 2.8 trillion cubic feet of gas with 1.5 billion gallons of gas liquids, with a total market value of $2.01 billion. Since the inception of the OCS leasing program, the cumulative value of offshore production in the Gulf of Mexico through 1971 has been $10.3 billion.

The hydrocarbon production of offshore Texas is predominantly gas, which has been developed along the Miocene trend and the original gas reserves amount to 1.6 trillion cubic feet from 17 fields. The original oil reserves of this Texas Miocene trend have been calculated to be 106 million barrels from eight fields.

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III. ENVIRONMENTAL IMPACT OF THE PROPOSED SALE

A. Introduction

The developmental and production activity following this proposed sale could result in a variety of impacts on the natural environment, on other Gulf of Mexico resource uses, on air and water quality, on land use patterns, on the social order, and on the economy. Some impacts are the unavoidable result of routine operations and the probability of their occurrence is 1, or 100%. Other impact-producing events must be viewed as accidental, not a part of day-to-day operations, but caused by occasional human error. Still other impacts are avoidable and can be controlled or avoided by safe operating practices and by regulations.

The remainder of this introductory section will be devoted to setting the stage for the discussion of actual impacts by briefly describing impact-producing operations and events, and where possible citing statistics and examples. The reader should be reminded that routine oil and gas operations are described in section I. F.

1. Unavoidable Type of Impacts Resulting From Day-to-Day Operations

As stated above, these are the unavoidable results of routine operations and include such events as:

- release of cleaned drilling fluids, drill cuttings and sand (see section I. F. 2. a.)
- release of produced formation water (see section I. F. 2. a)
- generation and disposal of solid waste (see section I. F. 3. c.)
- disruption of sea floor and resuspension of sediments during pipeling laying (see section I. F. 4.)
- dredging of trenches and "push-ditches" (see section I. F. 4.)
- placement of temporary and permanent platforms, boats, barges, and pipelines in conflict with commercial fishery trawling operations and ship navigation
- placement of structures, etc., pipeline burial cuts, ancillary onshore facilities where they may degrade the scenic values of the area.

The reader should bear in mind that a summary of unavoidable adverse environmental effects is presented as a separate section (V.).

2. Impacts Resulting from Accidents

In any complex industrial operation involving heavy equipment, flammable materials, work at sea, and large numbers of employees, it is inevitable that accidents will occur. Thus, although theoretically avoidable, impacts resulting from accidents can be viewed as unavoidable in a statistical sense. It has been possible to gather data and derive statistical frequencies for some of these events, and present it below.

a. Natural Gas Leaks Associated with Blowouts

Information furnished by the Geological Survey for the period 1956-1971 lists 30 gas leaks associated with well blowouts during OCS oil and gas operations in the Gulf of Mexico. Ten of these incidents involved fires and four were associated with oil or condensate spills. The duration of the blowouts ranged from two hours to over seven months. Several incidents included the loss of life and equipment but none of the leaking gas resulted in environmental damage. There are no estimates avaiable of the amount of gas lost.

b. Major Oil Spills

Data supplied by the Geological Survey for the period 1964-1971 indicates a total of 39 significant oil spills incidents connected with Federal OCS oil and gas operations in the Gulf of Mexico involving 50 bbl. or more of oil and condensate. The estimated total volume of oil spilled during this period as a result of these incidents is slightly less than 280,000 bbl. A distribution of these 39 incidents as to type and amount spilled is presented in Fig. 37.

(1) Pipeline Accidents

A word of explanation is required for the inordinately large amount of oil spilled due to dragging anchors

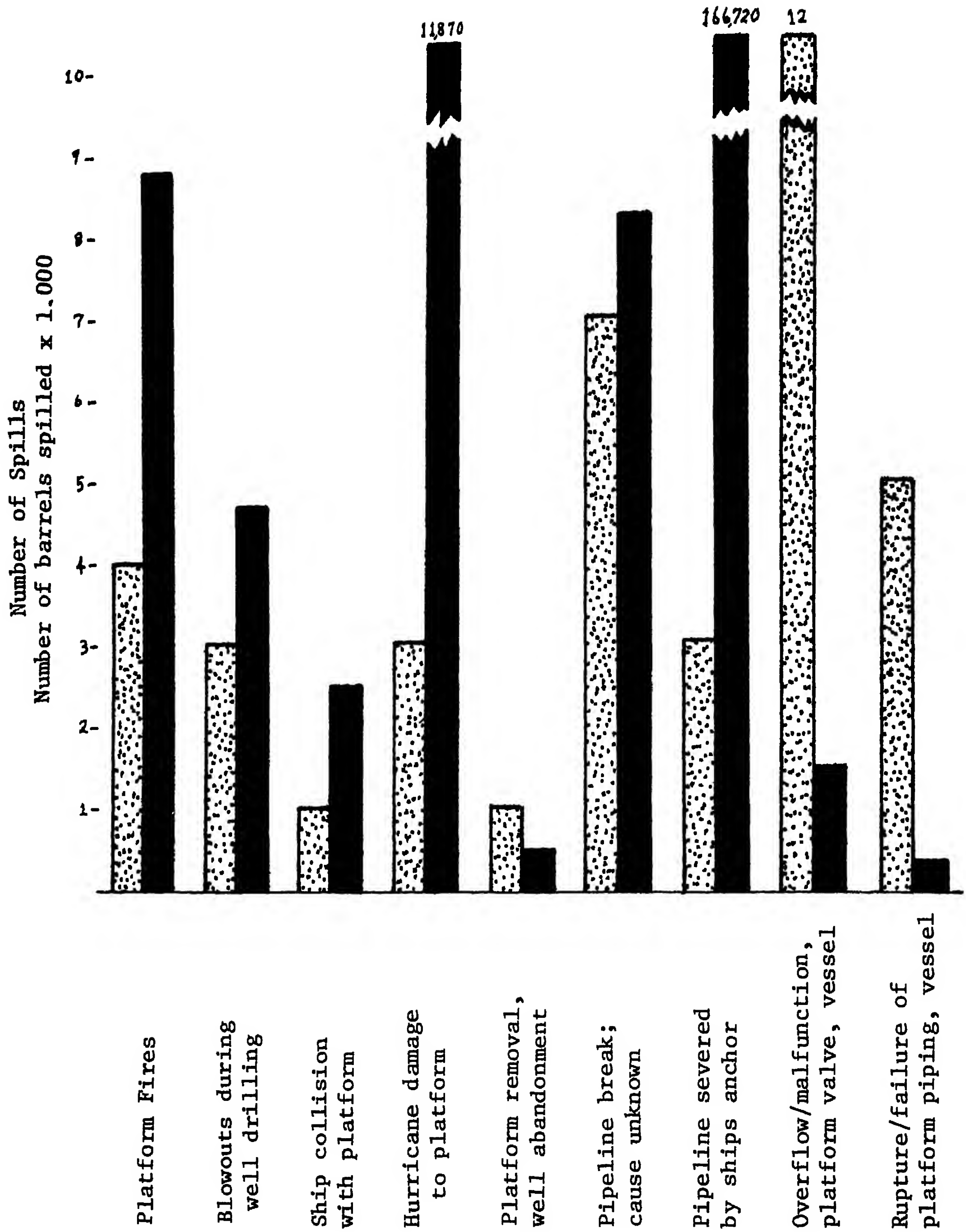
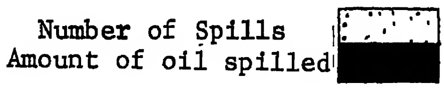


Figure 37. Major Oil Spills, Number and Amount. (Data from Geological Survey.)



severing pipelines. The largest oil spill in the history of oil production in the Gulf of Mexico occurred in October, 1967, when a ship dragging its anchor in a storm, broke a pipeline which lost over 160,000 bbl. of oil into the water.

Following the Santa Barbara incident (1969), and in some measure due to increased pressure from the shipping and fishing industries, the Bureau of Land Management has required burial of all pipelines with a minimum of three feet of cover out to a water depth of 200 feet. Where the pipelines cross shipping fairways and anchorage areas, they must be buried at least 10 feet deep. In addition, most pipelines laid before the burial requirement may be expected to have sunken into the unconsolidated sediments. Therefore, the chance for this type of accident decreases with the passage of time because fewer and fewer pipelines remain exposed at the surface.

(2) Well Blowouts During Drilling

One example of a blowout during well drilling is the Santa Barbara incident.

SANTA BARBARA SPILL 1/

On January 28, 1969, a blowout occurred below Union Oil Company's fixed drilling Platform A in the Santa Barbara Channel, about six miles southeast of Santa Barbara, California. This blowout and spill occurred through a fissure in the ocean floor adjacent to the well

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1/ Straughan and Kolpack (1971).

after gas under high pressure from a deep reservoir was accidentally injected into shallow reservoir sands. The resulting build-up of pressure in the shallow reservoir sands soon exceeded the strength of the overlying rock layer and caused a rupture to occur. The rupture formed a fissure zone, thus opening an avenue of communication betwen the hydrocarbon reservoir and the seabottom (Reinhart, 1970).

Total initial spillage was estimated by the Geological Survey to be 10,000 barrels, with subsequent leakage amounting to about 8,500 barrels. Other estimates of spillage range from 70,000 to 700,000 barrels. 1/

(3) Oil Spills Resulting from Platform Fires

Platform fires could be ignited by a variety of events. Most are probably caused by combustible hydrocarbon liquids or vapors being brought into contact with arcing electrical devices and overheated mechanical devices; more rarely they could be ignited by lightening or static electricity. Sometimes, platform fires first involve the accidental ignition of fuel, solvent, or heat exchange fluids. If caught soon enough, these small fires are usually controllable, but once a storage tank or well catches on fire, major structural damage occurs and adjacent producing wells on the platform may have their piping severed and also contribute to the fire.

1/ Testimony of Dr. Carl H. Oppenheimer, OCS Public Hearing of August 23, 1972, New Orleans, Louisiana.

If producing wells are damaged in a way that allows them to flow freely and be ignited, they are usually allowed to burn while operations are underway to control the wild well from a remote location. In this way, a high percentage of the hydrocarbon liquid expelled by the well is burned and little ocean pollution results. If a blowing well is releasing mostly or entirely natural gas, the possibility of ocean pollution is minimal. However, the safety of personnel and the security of the platform or drilling structure are imperiled should a fire occur. The decision whether or not to extinguish a gas fire depends on the circumstances of the moment. For example, it might be advisable to allow a gas well fire to burn while remedial action is being prepared if the structure and personnel are not in jeopardy. This would preclude accidental ignition while personnel were in the area of gas accumulation. The overall thrust, however, is quickly extinguishing the fire and bringing the well under control.

An example of an apparently spontaneous platform fire which resulted in the ignition of several producing wells and extensive damage to the platform is the Chevron Fire of 1970. 1/

On February 10, 1970, fire was observed on Platform "C" shortly after midnight from an adjacent platform. Platform "C" is located in 40

1/ U. S. Dept. of Interior (1970).

feet of water about 75 miles southeast of New Orleans, Louisiana. Field personnel boarded the burning platform but had to evacuate immediately because of the intense heat. During the following month, planning, construction and assembly of equipment for extinguishing the fire and controlling the anticipated oil spill was carried out. From March 10, through March 31, several methods were successfully used to control six of the seven wild wells on the platform (one well sanded up and plugged itself). These included dynamite, relief well drilling, wellhead repair, weighting and sealing chemicals, and activation of downhole safety valves.

Reliable estimates placed the total volume of oil spilled at about 30,000 barrels. Oil from the spill was a light crude, containing a high proportion of lower boiling constituents and a relatively low concentration (about 10%) of aromatic hydrocarbons. Through a fortunate set of circumstances, the oil was sprayed high into the air under great pressure and frequently into considerable wind, so that far more evaporation took place than is usually estimated to occur during a spill. Samples collected 500 feet from the platform and analyzed by Federal Water Quality Administration (FWQA) laboratories showed a loss in volume of 16 percent, all in the lighter ends. Also, about 5,000 barrels of oil were removed by skimming. Some 1,500 barrels of chemical emulsifier were used during the spill as well.

(4) Accidents Resulting from Production Well Workover, Platform Maintenance and Repair Work

Accidents caused by human error during routine rework, maintenance and repair have resulted in at least two large spills of oil, along with destruction of platforms, the loss of a work vessel and several human lives. On May 28, 1970, renovation and repair work was being carried out on a platform in Galveston Block 189-L, offshore Texas. The platform had been shut-down and workmen were sand-blasting, painting, torch-cutting, and welding. When welding was attempted on a line leading to a storage tank containing 2,000 bbl. of crude oil, a series of explosions occurred, resulting in the death of five workmen and injuries to six. Burning oil spilled onto a nearby service boat, nearly destroying it, and about 100 bbl. also reached shore, polluting Galveston beaches. (National Transportation Safety Board, 1970.)

The Bay Marchand Fire (Shell Fire and Spill) of 1970-71 was ignited as a result of human error. The plastic coating on the tubing of one well sloughed off and plugged the tube. During cleaning operations, workmen failed to close well control valves for a brief period while the well was left unattended. Plastic, used as a corrosion preventative in the tubing of well B-21, had sloughed off and lodged in the gate of the master valve. As the gate was closed, this plastic

compressed, preventing complete closure of the valve, but giving an indication that the valve was closed. The well appeared to be shut-in, but after 30-40 minutes the plastic began to slip through the gate opening and was finally released, thus opening the well to the atmosphere and allowing oil to escape.

Ten of the other 21 wells on the platform were damaged by subsequent falling debris and the intense heat of the fire. Four workmen died immediately. After five months, the last of the blowing wells was capped (Nelson, 1972). An undetermined amount of petroleum was consumed by the fire and 53,000 bbl. spilled into the sea. Such an accident on a gas producing platform might still result in loss of life and equipment but would cause significant impact on the environment only if toxic materials such as polychlorinated biophenyls present on the platform were also burned.

(5) Summary and Conclusions

During the period of 1964-1971, almost 2 billion bbl. of oil and condensate were produced in the Gulf of Mexico offshore Texas and Louisiana. The amount of recorded spills during this period represents 0.014% of all oil and condensate produced in the area during the same period.

Assuming that estimated production of oil on tracts proposed for offering in this sale will range from 5,000-11,000 bbl./day by the sixth year of leasing this would mean that by 1979-80 oil produc-

tion from these proposed tracts could range from 1.825 million to 4.015 million bbl./year. If 0.014% of past production is taken as the true spillage rate, then this would mean 260 to 560 bbl./year of oil produced from tracts included in the proposed lease sale, could be spilled. But all spills are accidents, and the volumes resulting cannot be predetermined nor, as the following indicates, can any trends be identified by looking at past data concerning volume or number of incidents.

Year	Number of Incidents	Total Production/bbl.	Total Spilled/bbl.	% of Production Spilled
1964	5	122,500,126	14,928	0.0122
1965	1	144,968,615	500	0.0003
1966	0	188,714,070	0	0
1967	2	221,861,614	160,704	0.072
1968	2	266,936,001	6,085	0.0023
1969	8	302,919,143	10,924	0.0036
1970	7	335,658,540	84,323	0.0251
1971	20	387,445,398	1,473	0.0004

The number of incidents show an increase beginning in 1969. This is the same year that Gulf of Mexico OCS operating orders became effective requiring the recording of all spills, reporting of all spills greater than 15 bbl., daily inspection of manned facilities and regular inspections of unmanned facilities. There has been a total of 10 oil spills of 1,000 bbl. or more in over 18 years of OCS leasing. Six out of the ten major oil spills occurred during the period from 1964-1968 and four during the period following implementation of the OCS operating orders of 1969-1971.

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c. Minor Spills

During the first nine months of 1972, 839 minor spills of less than 50 bbl. involving 836 barrels (42 gals/barrel) of oil were recorded by the Geological Survey from OCS oil and gas operations in the Gulf of Mexico. The majority of these spills (682) involved one barrel of oil or less totalling 170 bbl. One hundred and fifty-two of the recorded spills involved 1 to 15 barrels totalling 525 barrels. Only five spills exceeded 15 barrels of oil (141 barrels). An additional 499 oil slicks from unidentified sources were sighted in the first nine months of 1972 and are not positively related to offshore drilling. There is evidence of natural oil seepage in the Gulf of Mexico, first recorded in 1906, long before oil development activities were initiated, and seepage still persists in oil prone areas. It is possible that these natural seeps could be the source of some oil slicks classified as being from an "unidentified source".

d. Collisions Resulting From Conflict Between Ship Navigation and Offshore Structures

During the period July 1, 1962 through June 30, 1971, the Coast Guard recorded 24 incidents of collisions between vessels and fixed platforms. Total damages were estimated to be about $0.4 million to vessels and $3.4 million to the structures. Only four injuries and no deaths were reported. Of these, only eight accidents

involved vessels of over 1,000 gross tons; however, these eight accidents accounted for $87 thousand of vessel damage (only four vessels reported damage) and over $3.2 million to platforms and no injuries or deaths reported. Five of these accidents occurred at night (three within two hours of midnight) and two during daylight. All of the eight major accidents occurred outside established shipping fairways and anchorage areas and only three were less than five miles from these established areas. At least five of the accidents involved foreign flag vessels. The worst of these eight accidents occurred in 1967 when a 11600 ton foreign flag cargo vessel collided with a platform in Ship Shoal Area Block 214 at 1:30 a.m. during heavy rain, poor visibility, 45 knot winds and 15-20 foot seas. The vessel escaped with damages estimated at $12,000 but damages to the platforms were of the order of $1.1 million or 1/3 of the total damages to platforms in all eight accidents. Nearly one year following this collision a blowout of gas and condensate occurred on this platform. There was a minimal amount of oil spilled because the well was producing gas.

The remaining 16 incidents of collision between vessels (less than 1000 gross tons) and platforms caused more damage ($290 thousand) to the vessel than to the platforms ($100 thousand). Causes were assigned as 2-weather, 8-vessels and 6-platforms; the platforms causes were further defined as 3-equipment failures, 2-insufficient or improper lighting and 1-improper maintenance.

During the time period 1957-1971, the Geological Survey recorded only one significant spill of oil, 2,560 bbl., associated with ship-platform collisions.

e. Accidental Deaths and Injuries on Oil Industry Structures and Vessels

Information supplied by the U.S. Coast Guard reveals that a total of 94 individuals were killed as a result of accidents involving construction, supply, and drilling vessels, workboats, mobile drill rigs, and artificial islands in the Gulf of Mexico and adjacent navigable inland waters during the period 1964-1971. Of these 94 deaths, approximately 60 occurred in water approximately equal to the Federal OCS area. The following table, provided by the Coast Guard shows these casualties by source and year. These figures do not include deaths resulting from accidents in which no vessel or rig damage occurred (i.e., persons falling or knocked overboard, crushed by drilling equipment, etc.). Partial figures for fiscal year 1967 through 1971 indicate that approximately 25 persons were killed in oil operations in the Gulf of Mexico (both inland and international waters) with no casualty to the vessel being involved.

Based on the years 1967-71, the death rate due to offshore oil operations and involving vessel damage in international waters was 34 and in inland waters was 27. Distributing the 25 deaths not

Total Deaths Reported as Resulting from Vessel Casualty

	Inland Waters Gulf of Mexico								Gulf of Mexico							
	Fiscal Years															
	64	65	66	67	68	69	70	71	64	65	66	67	68	69	70	71
Mobile Drill Rigs and Artificial Islands	No info		-	7	-	12	-	-	No info		-	-	2	1	7	14
Oil Industry Supply Vessels and Workboats	-	-	-	-	-	-	3	2	1	-	2	-	-	-	-	4
Oil Industry Construction and Drilling Vessels	4	1	2	1	-	2	-	-	22	1	-	1	-	-	2	3
Sub Total	4	1	2	8	-	14	3	2	23	1	2	1	2	1	9	21

Total 94

involving vessel damage according to the 34:27 ratio, an additional 14 deaths may be added to the total for international waters, giving a grand total of 48 deaths for the five year period. Based upon this information, at least ten deaths per year may be expected in the Gulf of Mexico as a result of offshore oil industry activity in OCS waters.

Below are listed a summary of injuries reported to the Office of Workmen's Compensation Programs under the Outer Continental Shelf Lands Act by district 1/. The years are recorded as Fiscal years.

All Districts

Fiscal Year	Cases Reported		
	Non Fatal	Fatal	Total
1968	3,583	28	3,611
1969	3,395	25	3,420
1970	3,261	21	3,282
1971	2,822	32	2,854
1972	1,975	14	1,989

District 8 - Galveston Texas

1968	92	1	93
1969	121	1	122
1970	135	9	144
1971	28	-	28
1972	61	2	63

1/ U. S. Dept. Labor.

3. Impacts Which Can be Minimized or Avoided by Regulation and Safe Operating Practices

A more thorough discussion of regulations and operating orders is presented in section IV, "Mitigating Measures Included in the Proposed Action". For the purposes of the present action, some examples are given below.

a. Measures taken to prevent conflict between ship navigation and fixed structures

Coast Guard regulations require the marking of such structures by combinations of lights and horns.

b. Prevention of leaking from abandoned wells and prevention of formation to formation flow of fluids or gas

Geological Survey requires that all freshwater, oil, or gas bearing zones must be isolated with cement plugs, and that the upper portion of the well be plugged with cement before the well head is removed.

c. Prevention of pollution by liquid and solid waste

Geological Survey requires that no harmful liquid waste be released into the sea and that all solid waste except drilling muds, drill cuttings, and sand be incinerated or transported to shore for disposal.

B. Impact on the Living Component of the Environment

1. Impact on Biota of the Open Gulf

Except for the impact resulting from pipeline laying across the beach and through the coastal wetlands, most impacts resulting from this sale may be expected to exert their effects on the plants and animals of the open Gulf. Impacts in the open Gulf ecosystem will result from accidental loss of debris, discharge of drill cuttings, sand, drilling fluids, the burial of pipelines, and the accidental spillage of oil or other toxic materials. 1/

a. Impact on Pelagic Marine Life

Pelagic marine life includes a broad spectrum of organisms from all trophic levels and includes the phytoplankton, zooplankton, nekton (euphausids, shrimp, fish, squid, and marine mammals), and pelagic seabirds.

1/ In the Draft Environmental Statement concerning this proposal (pp. 238-240), it was pointed out that an exceedingly toxic and dangerous family of compounds, polychlorinated biphenyl liquids (PCB's) were used in heat transfer units on production platforms and thus were vulnerable to spillage into the water of the Gulf. The Department of the Interior has recognized that certain potential adverse environmental effects could result from the use of PCB's in liquid heat transfer units (their only application in OCS oil and gas operations). The Geological Survey noted that until recently, the impact of the introduction of PCB's to the environment has gone unnoticed, but present research on PCB's has identified them as being chronically toxic to the ecosystem. As a result, the GS has ordered that PCB's shall not be used in any offshore heat transfer system and that all heat transfer systems presently using PCB's shall be drained by June 1, 1973, and the PCB's properly disposed of in a method and location subject to the approval of the GS Oil and Gas Supervisor, Gulf of Mexico Area.

(1) Impact on the Plankton

Impacts that may be anticipated to have an effect on plankton will result from accidental spills of oil (and associated use of emulsifiers), and other toxic materials, discharge of drilling fluids, and formation waters, and burial of pipelines.

After an oil spill has occurred, that which has not evaporated, been carried ashore, or cleaned up will be dispersed as minute droplets in the water. Here they have the opportunity to damage marine organisms and enter the marine food chain. Hufford (1971) notes laboratory studies which indicate oil can affect phytoplankton after several days exposure. He cites laboratory experiments in which oil products in sea water cause lack of cellular division and death in phytoplankton. Apparently, cellular membranes were damaged by the penetration of hydrocarbons and this led to the extrusion of the cellular contents. During a study of the effects of the Santa Barbara spill, however, Oguri and Kanter (1971) found no conclusive evidence of a decrease in phytoplankton community productivity that could be attributed directly to the oil spill. Individual experiments indicated, however, that the use of dispersants may have resulted in marked reductions in productivity. They theorized that the longevity of any such effect would depend on the currents and rate of dilution, as well as the type and quality of the dispersant. No evidence was found in the literature that spilled oil enters the marine

food chain via adsorption or absorption by phytoplankton and subsequent ingestion by grazing herbivores.

Little information has been found concerning the effect of crude oil on the zooplankton. Hufford (1971) cites one experiment which showed accelerated death of zooplankton exposed to diesel oil (0.1% for 5 to 60 minutes) as compared to non-exposed zooplankton. Zooplankton have been observed to ingest spilled Bunker C oil particles, however, with no apparent effect. Members of the Operation Oil (1970) task force, studying the effects of spilled Bunker C from the tanker Arrow in Chedubucto Bay, Nova Scotia, observed that many copepods in the area had apparently ingested small oil particles and 2.4% Bunker C was found in the feces of one species. They noted that animals containing smaller oil particles voided these within 24 hours and showed no signs of distress. That they continue normal activities with no apparent harm is quite important in consideration of the marine food chain, because they can be eaten by small fishes and filter-feeder organisms while carrying the oil in the gut. These in turn may be eaten by large predatory animals and thus all conditions are present for a classic example of biological magnification of a potentially harmful or toxic compound. A similar effect could be expected if other toxic materials such as diesel fuel, solvents, or heat exchanger fluids were spilled during handling or as a result of platform damage.

The preceeding discussion includes only the results of massive, infrequent spills. However, statistical evidence exists (see section III. A.) that small spills of fractions of a barrel to 50 barrels occur on the order of a thousand times per year in the Gulf of Mexico. The problem of determining potential impact from chronic, low-level spillage is difficult. Virtually none of the reports of scientific investigations on oil spillage, which we were able to obtain, addressed the effects of low-level, continuous spillage in offshore water. It is difficult to assign potential damage to one group of organisms, i.e., plankton, but it seems appropriate to discuss the problem at this point. A few scientists have offered cautious speculation. A more pessimistic view is taken by Blumer (1969) who has stated:

> "...we are rather ignorant about long-term and low level effects of crude oil pollution. I fear that these may well be far more serious and long lasting than the more obvious short-term effects." Blumer (ibid.) then points out that hydrocarbons are taken up into the food chain, and through the process of 'biological magnification', can become concentrated in marine species used by man for food. He states "One consequence will be the incorporation into food of materials which produce an undesirable flavor. A far more serious effect is the potential accumu-

lation in human food of long-term poisons derived from crude oil, for instance of carcinogenic compounds." Blumer also cautions that low level pollution may damage the marine ecology by masking natural chemical sex attractants, interfering with chemical food sensing and enemy repulsion. He states, "There is good reason to believe that pollution interferes with these processes in two ways: by blocking the taste receptors and by mimicking for natural stimuli;. . ."

A somewhat less pessimistic view is taken by St. Amant (1972). In offshore areas, where chronic spills could result from leaking vessels and plumbing, and discharge of oil-contaminated, produced brine waters, St. Amant views the problem as follows: "Chronic pollution from offshore production sites represents an unknown factor. Daily drips and loss of small amounts of oil or other chemicals overboard do not appear to generate ecological problems because of the relative immensity of the water column. Whether such sublethal pollution will eventually accumulate and cause environmental degradation is yet to be determined. Because of this unknown factor, significant effort should be made to prevent low-level pollution."

A still less pessimistic view is taken by Oppenheimer. 1/ He notes that hydrocarbons have been a part of the natural environment since

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1/ Oral and written testimony given by Dr. Carl Oppenheimer of Univ. Texas Marine Station at the OCS Public Hearing on a proposed oil and gas lease sale offshore Louisiana. August 23, 1972. New Orleans, Louisiana.

life began. Also, that "...except for the commercial concentrations of oil in our geosphere, no recognizable concentration of specific molecules have persisted in the aquatic environment other than tar balls, as microorganisms are ubiquitous in their role in mineralization or recycling of the hydrocarbons in natural environments."

Oppenheimer continues: "There is a priori evidence that hydrocarbons may in some areas be significant as a nutrient source for living organisms. It may not be surprising when one looks at the pathway of hydrocarbon degradation. A first step of degradation is the formation of fatty acids which is a good source of food for marine organisms. It is interesting to note that the fish catch in the oil producing areas of Louisiana has increased materially during the past 30 years. Fishing effort in the Gulf remained somewhat constant over the last 10 years with 10,000 small boats and 3,500 vessels operating... Logic tells us that fish must be present if they are being caught. This fish catch increase is in an area where nearly 3 billion barrels of oil have been produced over the last 40 years. I find that total fish catch, as it represents the top of the food chain, can be a good indicator for the state of the environment." In his summary, Oppenheimer notes "...there (is) no conclusive evidence of long-term adverse oil effects on the living populations,..."

The regular discharge of formation waters, "brines", could have a severe impact on the plankton, but the effect would be extremely localized. Although the water is put through a polishing facility and has all but traces of entrained oil removed, it contains a heavy concentration of dissolved salts 1/ and is devoid of dissolved oyxgen. It could be anticipated that the release of this water would result in a plume trailing away from the point of discharge in the direction of the current with a core of perhaps a few feet in diameter and tens of feet in length that would be harmful or lethal to the plankton. Physiological stress would probably result from an osmotic imbalance (cells losing water to surrounding brine) and low dissolved oxygen leading to suffocation. Beyond the zone of stress, however, one author has actually noted a zone of stimulation or fertilization during a study of brine discharge in Galveston Bay (Mackin, 1971).

The remaining impacts suffered by the plankton will also be extremely localized, and are all related to increased turbidity. These impacts are brought on by the discharge of drilling fluids and drill cuttings, and the jetting of sediments during underwater pipeline burial. The turbidity resulting from these operations trails away as a visible

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1/ An average of 141,473 mg/1 was found in the examination of over 80 samples of formation water taken from South Louisiana and the OCS. This value may be compared to the world average of 35,000 mg/1 for natural seawater.

plume in the direction of local currents and usually disappears within a few yards to a mile from the source. The effect of this turbidity on a given parcel of water is of short duration, lasting on the order of a few hours at the most. The physiological effect would be to curtail the penetration of sunlight, and therefore, depress synthesis by phytoplankton. It is our conclusion that the effect would be immeasurably small at more than a few feet from the point of discharge.

(2) Impact on the Nekton

Nekton, by definition, include all marine animals which are active swimmers and are able to migrate freely over considerable distances. This motility, combined with their ability to sence irritation and with their natural escape and avoidance behavior, enables them to flee localized adverse conditions.

Therefore, the only significant impact that members of the nekton could suffer would result from a massive oil spill.

No information has been found on the effect of spilled oil on members of the nekton other than fish. Hufford (1971) cites several early studies which show that crude and bunker oils harmed or killed fish eggs in laboratory experiments. He also cites

Mironov (1970) who found that oil affects fish respiration by clogging gills and damaging gill tissue. A more common (and easier) approach to studying the effects of oil on fish is to expose them to varying amounts of oil in a laboratory aquarium (e.g., Spears, 1970) but this is not of great value in assessing the impact of spilled oil in the ocean because of the vast difference between an aquarium and the ocean and the fact that oil concentrations in the water during a spill are rarely known. Rice (1973) has noted in laboratory studies that pink salmon fry are able to detect low, sublethal concentrations (as low as 1.6 mg/1 of oil for older fry) of Prudhoe Bay crude and show avoidance behavior to it. He acknowledges that the effects of sublethal concentrations of oil on salmon migrations are unknown, but emphasizes that the potential for harm is clear. (Salmon, of course, do not inhabit the Gulf of Mexico.)

The potential for damage to nekton is clear, but at this time we are unable to predict the scope of the impact, should the proposed sale be held. Based on past observations, we estimate that it would be low.

(3) Impact on Pelagic Seabirds

In the past, the injury and death of thousands of seabirds has been the most obvious impact of massive oil spills.

Shelton (1971) states that "The causes of death of oil-contaminated birds are usually complex. Clogging of plumage greatly reduces its insulating properties, while ingestion of oil during preening can cause a variety of pathological conditions including severe enteritis with necrosis of the duodenum... This, in combination with increased heat losses, may reduce feeding activity and a marked drop then occurs in the fat reserves of the bird, followed by muscular emaciation. It is in this critical condition that most oiled birds arrive on the shore, where further stresses are placed upon them by cleaning and attempts at rehabilitation. It is not therefore surprising that the mortality rate at cleaning centers is normally very high indeed."

The table on the following page lists oil spilled-related bird mortalities as noted in the literature.

Based on experience during past oil spills in the Gulf, and also based on the small numbers of pelagic seabirds in the Gulf, we conclude that seabird mortalities will probably not be great if an oil spill occurs during developmental and production activity resulting from this proposal.

No. Birds Affected	Source of Spill	Material Spilled	Location	Year	
3,600	Platform	crude oil	Santa Barbara, Calif.	1969	*
200	not specified	diesel oil	Firth of Forth, Scotland	1969	**
9,000	not specified	fuel oil	Aberdeenshire, Scotland	1970	**
1,000	not specified	"Oil"	Southwest England	1970	**
12,000 (Contaminated)		fuel oil	Northeast England	1970	**
1,000 (Contaminated)	Tanker		Southern England	1970	**
2,300	Tanker _Arrow_	Bunker C	Chedabucto Bay, Nova Scotia	1970	**
none	Platform-Chevron	crude oil	Offshore Louisiana	1970	**
1,000 (Contaminated)	Tanker _Delian Appollon_	Bunker C	Tampa Bay, Florida	1970	**
1,000	not specified	weathered oil	Martha's Vinyard, Mass.	1970	**
96,000	not specified	"Oil"	Kodiak and adjacent Is., Alaska	1970	**
none	Shell Platform	crude oil	Offshore Louisiana	1970	***
6,000	Tankers-Standard Oil Co.	Bunker C	San Francisco Bay, Calif.	1971	****
none	Amoco Platform	crude oil	Offshore Louisiana	1971	***

* Straughan, 1971a. ** _Environment_ Editorial Staff, 1971.

*** Testimony of Dr. Carl Oppenheimer, OCS Public Hearing, New Orleans, Louisiana, Aug. 23, 1972.

**** Chan, 1972.

At this time, we know of no other impacts caused by oil and gas operations that have a direct effect on bird life. Indirect impacts could include loss of habitat and nesting areas due to installation of onshore facilities. We believe the removal of about five acres of wetlands habitat for onshore facilities will not constitute a serious loss of habitat.

b. Impact on Benthic Marine Life

In the northwestern Gulf of Mexico, the benthos is composed almost entirely of animals and saprophytes 1/; the soft muddy, sandy substrate, and turbid water is not suitable habitat for benthic algae such as sea lettuce and kelp. Environmental impacts which may be expected to effect benthic life adversely will result from the discharge of drill cuttings, accidental spillage of oil (and associated use of emulsifiers) and other toxic materials, and the burial of newly constructed pipelines.

Spilled oil which has not evaporated or been cleaned up or stranded on a beach, after being dispersed into the water as droplets, adheres to particulate matter and sinks to the bottom where it comes into direct contact with the benthos. One study of the effects of oil on subtidal benthic communities is that of Fauchald (1971), carried out

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1/ (saprophytes) lower plant life whose mode of nutrition is absorption of nutrient from non-living organic material, i.e., organisms of decay.

to determine possible damage caused by the Santa Barbara spill. One of the major organisms studied was a frequently occurring marine worm, Listriolobus pelodes (not present in northwestern Gulf of Mexico). After considerable sampling, Fauchald concluded, "There are no indications that it has been totally exterminated or even reduced markedly in the vicinity of Platform A. In fact, in one of the box cores taken in October, 1969, as part of the bacteriological survey, a relatively small, but otherwise normal, L. pelodes was found sitting in its shallow depressiong surrounded by an inch-thick layer of black mud mixed with crude oil." The author theorized that fluctuations in numbers of benthic animals observed may have been due to natural causes or oil well drilling activity in the area, or the oil spill or sewage pollution, but states that no effects directly attributable to the oil spill could be seen. The author qualified this, however, by mentioning that with the technique used it was not possible to separate the effects of the oil spill from the general background "noise" of other factors influencing the benthos. In the Arrow spill study (Operation Oil, 1970), lobsters appeared to be clean and normal in behavior. Scallops taken near heavily oiled beaches, were cooked and eaten and had no oily taste, but chemical analysis of scallops, along with periwinkles, sea urchins, and other bottom dwelling organisms revealed that oil was present in the digestive tract, other organs, and muscle tissue.

Data of Sanders, Grassle, and Hampson (1972) show immediate and nearly complete mortality of many forms of benthic animals following the spill of No. 2 fuel oil near West Falmouth, Massachusetts. The bivalve molluscs (clams, etc.) seemed especially vulnerable. As a rule, when concentration levels of oil in the sediment apparently decrease below a certain level, with the passing of time, affected areas were recolonized by resistant forms, especially the marine polychaetous worm Capitella capitata. This generally occurred with in three to six months of the initial oiling. With the passage of about 10 to 20 months, the more sensitive molluscs resettled many areas. However, at some harbor stations apparently receiving a heavy oiling, some highly sensitive forms such as the ampeliscid amphipods 1/ had not returned. Farther offshore, this required about six months.

Chemical analysis of edible shellfish species made following the West Falmouth spill revealed that the fuel oil had been absorbed or ingested and could subsequently be found in oyster bodies and scallop muscles in quantities sufficient to require the closure of shellfish beds to harvesting (Blumer, Souza, and Sass, 1970).

1/ A family of crustaceans related to the common beach hopper or beach flea.

It is especially significant that contaminated shellfish elicited no oily taste when eaten--which sheds considerable doubt on the practice of determining pollution levels by taste tests, as is common in many areas.

During drilling operations, drill cuttings are separated from the drilling fluid, cleaned of any entrained oil and discharged into the ocean. A diver survey during one operation revealed that the drill cuttings could be detected over a circle 100 feet in diameter. In a small area in the center, the deposit appeared to be about four feet thick. The same survey of the cuttings deposit showed that benthic animals either migrated up through the deposit as it accumulated or colonized even as deposition continued because it appeared to be inhabited by several animals characteristic of "normal" benthic fauna.

In water depths of less than 200 feet new pipelines are entrenched by jetting away the sediment beneath the pipe and allowing it to settle into the underlying trench. Subsequent burial is allowed to take place naturally, primarily by reworking of sediments by bottom currents. The jetting process physically disrupts the sediments in its path and also causes resuspension of large quantities of sediment.

Most, if not all benthic fauna are either destroyed by the jetting or raised into the surrounding water and rendered completely vulnerable to predation. Although recolonization would begin

immediately, the native fauna could not be fully restored until seasonal reproduction cycles had been completed by representative species from adjacent areas, which would provide a supply of larvae to settle and enter the reworked substrate.

Turbidity resulting from resuspended sediment is capable of inflicting an adverse impact on filter-feeding apparatus or blocking respiratory surfaces. Casual observation had revealed that ocean currents carry the sediment and redeposit it at varying distances away, depending upon the particle size of the sediment.

Another possible source of impact is the resuspension of toxic heavy metals and persistent pesticides that may have been deposited in the area by a polluted stream and runoff. The possibility exists that these toxic materials could be ingested by lower marine life and could then be magnified through the food chain until it accumulated in serious quantities in top carnivores, including species harvested for human food.

No concrete information has been found which would lead us to conclude that the benthos of the Gulf of Mexico will suffer a measurable impact as a result of this sale. The possibility of impact by resuspended toxic heavy metals and persistent pesticides exists, but the potential for the occurrence, location, scope and duration of the impact are unknown.

2. Impact on Beach and Associated Biota

All shorelines in the northwestern Gulf are sandy to muddy with no naturally occurring rock; the tidal range is small (approximately 2 feet); the beach is populated by flora such as sea oats, beach tea, sunflower, and fauna such as coquina clams, mole crabs, ghost shrimp, coyotes, a few rodents, reptiles, and gulls, plovers, and sandpipers. Impacts on the beach could result from contamination by spilled oil and from disruption in the path of pipeline burial excavations.

A study of three sandy beaches oiled during the Santa Barbara spill (Trask, 1971) revealed no conclusive results concerning the impact on marine fauna. Severe beach erosion in early spring (a common feature of Pacific beaches in winter and early spring) removed oil pollution, large amounts of sand, and much of the associated fauna and rendered definitive evidence of any possible impact unobtainable.

During the *Arrow* spill study (Operation Oil, 1970), excavation of clams revealed oil extending down most burrows and often forming a pool at the bottom. Clams generally moved up the burrow to evade the pools, and sometimes left the entire substrate. Some mortality occurred and even the live clams were uresponsive, although they recovered with prolonged exposure to air.

Other pollution studies for the littoral zone are concerned with rocky shorelines and their characteristic assemblages of seaweeds, barnacles, limpits, anemones, etc. and bear little relationship to conditions in the Gulf of Mexico except for consideration of physiological stresses leading to death in oiled plants and animals. To generalize, where organisms have been covered by crude oil and Bunker C fuel oil, death is primarily blamed on smothering due to the physical coating, (e.g., Chan, 1972; Nicholson and Cimberg, 1971). When the pollutant has been a lighter refined oil (No. 2 fuel oil, diesel fuel), death and stress has been associated primarily with toxic effects of the oil (e.g., North, Neushul, and Clendenning, 1964; Texas Instruments, Inc., 1971).

It is also possible that shorebirds could receive an oiling. The results would be the same as for pelagic seabirds.

During pipeline laying operations, pipelines are buried by jetting up to a point where the jetting barge would be in danger of shoaling if further progress were made. From this point on, the pipeline is usually buried by the use of a suction, clamshell or bucket dredge. As this operation crosses the beach, it will disrupt and rework the sand for a width on the order of 30 feet.

Burrowing animals and rooted plants in the path of the operation will be killed or damaged. At least one growing season would be required for the impact to be abated. No resultant beach erosion by wind is anticipated due to the high moisture content of the upper Texas beach sands.

We expect the environmental impact to be low, primarily because of the sparsity of vulnerable plants and animals (other than microscopic organisms) on the beach.

3. Impacts on Embayments, Channels, Water Courses and Associated Biota 1/

The estuarine and inland waters that could be affected by operations resulting from this proposal are the East, West, Trinity, and Galveston Bay systems, the Intracoastal Waterway, and the small, brackish water Salt Bayou system which courses through about 20 miles of the coastal marshes discharging into the tailwater of Sabine Lake.

1/ An extensive discussion of the effect of dredging pipeline routes through bays and other coastal zone waters was presented in the Draft Statement (pp. 213-219). Since the Draft Statement was released, it has been learned that no new pipelines will be laid across a bay system, and the discussion is now inapplicable.

Concern was expressed in the Draft Statement (pp. 236-238) that the discharge of oil field brines in bays, small lakes, tidal bayous, and streams would result in a moderate to severe impact on aquatic life. Since the Draft Statement was released, it has been learned that all produced formation waters will be discharged at sea or injected back into the formation. Therefore, the discussion of the effects of brines in all but the open Gulf is inapplicable.

Living organisms in these bodies of water could be adversely affected by spilled oil (Galveston Bay System) and by dredging activity during the burial of new pipelines (Intracoastal Waterway, Salt Bayou System).

Oil pollution in the semi-enclosed waters of the Galveston Bay system could be more serious than that in the sea or along the open coast line because the pollutant would be, relatively speaking, entrapped, with tidal flushing being its only source of removal. Many species undergoing early development in estuarine waters are vulnerable to even small quantities of toxic compounds containing oil. In an early study of bay and bayou pollution, Mackin and Sparks (1962) noted that oiling of oysters by a wild well had no effect so far as survival was concerned. Mortality in oiled oyster beds was not statistically different from that in unoiled beds. Their data also showed that potential stress to the oysters by oiling did not increase the incidence of infection by a common oyster pathogen, *Dermacystidium marinum*. Mackin and Sparks may have erroneously judged the oysters to be free of petroleum contamination however, by using a taste-test of the oysters as the sole criterion for judgment. Zitco and Carson (1970), as cited in the Chedabucto Bay pollution by the Tanker *Arrow* noted oil in the muscles, gut, and other organs of scallops that had no oily taste. Blumer (1971) has stated "unfortunately, chemical analysis (of potentially contaminated edible species) has not been used to support...studies in the past

and conclusions on the persistence of oil in the environment have been arrived at solely by visual inspection... Marine foods may be polluted by petroleum and may be hazardous to man but neither taste nor visual observation may disclose the presence of the toxic hydrocarbons."

Besides Mackin and Sparks (1962) study, no others are available which treat conditions even remotely similar to pollution in semi-enclosed waters bordering the Gulf of Mexico. The Chedabucto Bay *Arrow* spill and West Falmouth-Buzzards Bay incidents have already been discussed. The *Tampico* spill in 1957 released 55,200 bbl. of No. 2 fuel oil into a small marine cove of Baja, California. The oil lost was contained in the cove, resulting in the immediate kill of all forms of marine life, and recovery to pre-spill conditions was estimated to be approximately 6 years, although sublethal effects may have persisted longer (North, *et. al*., 1964).

Any new pipelines constructed will cross the Intracoastal Waterway. They may also cross the small, brackish water Salt Bayou Channel. As described in section I. F. 4., the soil in this region is firm enough to allow the use of shove-ditch and back-fill type of burial. All excavation, with the exception of that through the Intracoastal Waterway, is done by rubber-tire and track mounted dredges usually operated on portable pads. Spoil taken from the excavated ditch

is firm enough to be shoved back into the ditch, burying the new pipe and restoring the terrain to original contours. In order to bury the pipeline beneath the channel of the Intracoastal Waterway, a barge-mounted suction dredge would most likely be necessary. At least one company buries the pipeline several feet below the mud level and weights it down with oystershell. 1/

It is not believed that brief additional dredging activity in the Intracoastal Waterway could cause any further degradation of the water quality and aquatic "habitat". This waterway is continually being dredged to maintan its depth and bears a heavy load of barge traffic at all times. There is little-to-no flushing and the water contains a tremendous sediment load at all times.

We know little about the existing condition of Salt Bayou. It is a natural drainage course and apparently has never been deepened or channelized. It is probably relatively undisturbed (Fisher, et. al., (in press) portray it as a system of lakes and ponds with minimum modification) except for adjacent agriculture and grazing. Dredging a shove-ditch across its channel will result in abnormally high levels of turbidity for the duration of the work (a few days). Immobile organisms living in the path of the pipeline will be killed.

1/ Testimony of William P. Heineman, OCS Public Hearing, February 21, 1973.

4. Impact on Wetlands

The wetlands includes the mudflats, sand flats, coastal marshes, and bay and barrier island fringing marshes. Dominant vegetation consists of spartina-type grasses and algae. Dominant fauna are the microconsumers (insects, worms, protozoa), although the most obvious and noticable animals are the large populations of waterfowl and wading birds.

Three types of adverse impacts are possible in the wetlands environment: pollution by spilled oil, disturbance during pipeline construction, loss of habitat by lands taken for installation of onshore pipeline terminals and gas treating facilities.

No information has been found concerning the effects of oil in the Gulf states wetlands. One British study of salt marsh oiling followed a "moderately severe" spill of crude oil in Milford Haven estuary, Wales (Baker, 1971). The author found that two weeks after the spill, oily salt marsh vegetation had turned yellow and was dying, but new green growth was showing at the base of some species. One year later there were still dead patches in some communities but weedy annuals were colonizing these patches. No observations were made of salt marsh fauna, but it could be expected that all aquatic species would be killed in the area affected by the spill. Most likely, a marsh spill would not spread far because of the physical hindrance caused by rooted vegetation, natural stream levees, canal spoil banks, and roads.

The method of pipeline burial in the marshes has already been discussed in section I. F. 4. and III. B. 3. The resulting impact will be the physical destruction of vegetation and immobile fauna in the path of the pipeline laying operation. We conclude that the impact on a narrow band of marsh in the path of the pipeline operation will be severe. We believe its duration will be short, as past experience in the northeastern Texas coastal marshes has shown that recovery of biota over the backfilled pipeline ditch is largely completed during the following growing season. During recent field reconnaissance by Bureau of Land Management personnel, involving travel by air, auto, and foot, it proved to be extremely difficult and in some cases impossible to locate the routes of several pipelines laid through the marsh three years before. It was noted that restoration of terrain and recovery of marsh vegetation was thorough and complete.

It hs been estimated that the proposed sale will result in the construction of up to three new pipelines. In turn, these new pipelines will probably result in the construction of onshore pipeline terminals or gas treatment facilities. The resulting impact will be the removal of a small amount of marsh habitat (on the order of 5 acres or less).

5. Impact on Unique Environments - The Coral Reefs of The Flower Gardens and the Tropical Reef Community of Stetson Bank

These unique communities would experience damage if drill cuttings or other sedimentary materials were discharged onto them.

Sedimentation is inimical to healthy coral growth. Although corals can cleanse themselves of moderate amounts of sediment falling from above, most cannot live for long if heavily coated or buried. Diversity of coral species decreases as one moves from clear to turbid waters and coral larvae cannot settle or survive on an unconsolidated substrate (Johannes, 1972).

Thus, we are concerned that the discharge of drill cuttings and drilling fluids in the immediate vicinity of the Flower Gardens and Stetson Bank 1/ could cause damage to the biotic communities on them.

An examination of the existing situation reveals that the Flower Gardens are located more than approximately three miles from the nearest tract proposed for leasing at this time. Therefore, it is unlikely that sedimentary material will reach them and an impact will not occur.

Stetson Bank is located in blocks A-520 and A-513 of High Island Area, South Addition, both of which are proposed for leasing at

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1/ Stetson Bank does not support a living coral reef, but nevertheless contains a biological community which is rich and unique, containing a diverse tropical reef fish population, sponges, stinging corals and other epifauna. Therefore, it deserves to be given special consideration here.

this time. Because of the potential for well drilling in the immediate vicinity, it is likely that damage could occur to the Stetson Bank community. If drill cuttings and drilling fluids are deposited on Stetson Bank, a portion of its epifauna will be damaged or killed and this, in turn, will result in a decrease in the bank's fish population. A special stipulation suggested for the protection of Stetson Bank is presented in section IV. D. 1.

C. Impact on Air and Water Quality

1. Impact on Air Quality

The quality of air over the sale area could be degraded by exhaust emissions of stationary power units and service vessels, and by the accidental release of oil and gas from wild wells.

The impact of exhaust emissions is unknown, but thought to be small and unimportant.

According to one authority 1/ the average composition of Natural Gas as delivered to pipelines in the U.S. is:

Methane	CH_4	72.3%
Ethane	C_2H_6	14.4%
Carbon dioxide	CO_2	0.5%
Nitrogen	N_2	12.8%

(Small amounts of sulphur and other materials could also be present in some localities.)

If the wild well were not burning, obviously, the above gases would be released into the air. If the gas well was on fire, combustion would be essentially complete and the emissions would consist almost entirely of carbon dioxide (CO_2) and water; the nitrogen would remain as N_2 and any sulfurous gases would be oxidized to SO_2. The resulting impact would not be great.

1/ Henry A. Ley. "Natural Gas", in Geology of Natural Gas, Amer. Assoc. Petrol. Geol. Tulsa, Okla. (1935) pp. 1073-1149. as cited by Levorsen (1958).

If a wild oil well were releasing crude oil onto the water, the resulting impact would be substantially greater. If the oil does not burn, a significant amount of it will evaporate. During the Chevron, 1970, spill it was estimated that 15% of the roughly 30,000 bbl. spilled evaporated. At an average density of 310 lb./bbl., this incident would have introduced almost 14,000 lb. of hydrocarbons into the air. Some oil spills in the past have resulted in fires.

A reasonable estimate of the range of emissions, assuming complete combustion, that an oil well fire could produce per 1,000 bbl. burned, might be as follows 1/:

CO_2	:	340,000-347,000 lb.
SO_2	:	620- 34,000 lb. 2/
NO	:	660- 10,000 lb.

(As a point of reference, during the Chevron - 1970 fire and spill, the maximum spillage rate was estimated to be 1,000 bbl. per day.)

Combustion of oil would in reality be incomplete, however, and emission would contain somewhat less of the above compounds, but would include, in addition, such materials as volatilized petroleum,

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1/ Values used in calculation are based on world averages for crude oil of 310 lb/bbl.; Percent content by weight is: carbon 82.2 to 87.1, sulfur - 0.1 to 5.5, nitrogen - 0.1 to 1.5 (Levorsen, 1958).

2/ SO_2 emission would be less for Gulf of Mexico crudes, which range from 0.1 to 0.5% sulphur.

particulate carbon, carbon monoxide, nitrous oxide, sulphur monoxide, along with other altered or partially oxidized matter. There is no reliable way to predict in advance the relative volumes of each of these possible emissions because it would depend, among other things, upon moisture content of the air, wind speed, pattern of oil spray from wild wells, number of wells involved, chemical content and physical character of the oil itself, and types of equipment and materials other than oil that might also burn.

Massive spills from wild wells are not the only source of spilled oil. Information presented in section III. A. 2. c. demonstrates that over 800 bbl. were spilled in the first nine months of 1972 as the result of an equal number of minor spills. The net result is that a small amount of spilled oil is floating somewhere on the waters of the northwestern Gulf almost continually. Concern has been expressed 1/ that the evaporation of this spilled oil may be the cause of the substantial levels of hydrocarbons which have been detected in the sea breeze coming off the Gulf. Preliminary surveys 2/ indicate that the content of reactive (smog-producing) hydrocarbons in the sea breeze between Corpus Christi and Port Arthur are at a level three times higher than the national average. At the present time there is no hard evidence as to the source of these materials.

1/ Personal communication with Mr. Kenneth Ports. Texas Air Pollution Control Service.

2/ Ibid.

At this time, we are unable to predict the degree of deterioration in air quality that will occur because of this proposed sale.

2. Impact on Water Quality

The natural condition of sea water may be altered and degraded in several ways during oil and gas operations.

Debris and bilge will be released into Gulf waters from the many seismic vessels, crew boats, tugs, and service and supply boats used throughout the operation. No estimate can be made of the quantities involved. They should be similar to amounts released off all types of vessels nationwide.

During drilling operations, drilling fluids and drill cuttings will be discharged into the sea. Most drill cuttings in the Gulf consist of sand and shales and therefore cause no turbidity, but settle to the bottom quite rapidly, on the order of minutes. The chemicals used in drilling muds have a relatively low level of toxicity and are all clay-type emulsions and when discharged, produce a plume of turbidity in the water near the surface. The visible plume is on the order of a few feet wide and a few yards long.

It has been estimated that an average of two cubic yards of such materials is discharged during the course of drilling from a given platform.

The production and discharge of formation waters (oil-field brines) has been discussed earlier (section I. F. 3. b.). Three components or properties of formation waters contribute to water quality degradation when released into the sea. One is the small amount of entrained liquid hydrocarbon. There are some locations disposing of formation water where the treatment equipment puts out an effluent with less than 25 ppm oil content, but the facts also show that this control is not being accomplished across the board on a continuing basis. Many other locations only manage to meet the requirements of OCS Order No. 8, releasing waters with entrained oil averaging less than 50 ppm. The second property of formation water that degrades water quality is its high concentration of dissolved mineral salts. This value ranged from 61,552 mg/l to 270,400 mg/l in 76 samples from the OCS off Louisiana. This contrasts sharply to the average sea water salinity of 35,000 mg/l. The third degrading property results from the fact that formation waters are void of dissolved oxygen. Unfortunately, no estimate of the amount of formation water to be discharged as a result of this sale can be made at this time.

Water quality could be further degraded as the result of accidental oil spills. It was estimated in section III. A. 2. that, based on a statistical rate of past major oil spills, 260 to 560 bbl./year could be spilled from tracts included in this sale. (In addition, a few dozen bbls. would likely be released through minor spills.

Part of this spilled oil would be removed by clean-up operations and some would evaporate, but the largest proportion would probably be dispersed into the waters of the Gulf.

Another source of water quality degradation is the resuspension of sediment during pipeline construction and burial. This operation was discussed in section I. F. 4. The jetting away of substrate from beneath the pipeline will result in creating a plume of turbidity trailing away from the operations in the direction of the current. The plume can reach proportions of several yards wide and hundreds of yards long if the substrate is exceptionally muddy. The duration appears to be on the order of several hours at a given location.

D. Impact on Commercial Fisheries

Three types of impacts interfere with commercial Gulf fisheries.

1. Removal of Sea Floor From Use by Trawlers

All shrimp and industrial bottom fish are caught by dragging a large trawl across the sea floor. Every site occupied by a drilling or production platform and its attendant service boats and barges must be avoided by trawlers. If the structure is a jack-up drilling rig or permanent production platform, the area of sea floor removed would amount to 2 to 5 acres. In deeper waters (over 300 feet) a semi-submersible drilling rig with its anchoring system would occupy up to 325 acres (assuming a 1500 foot anchoring radius). The duration of exploratory drilling ranges from under 45 days for a single well to around six months for multiple well explorations. Permanent production platforms may remain in place for 10 to over 20 years.

The probability that permanent platforms will be erected on each tract, based on past exploration success rates, is about 35%. This is to say that approximately 1 out of every 3 tracts offered for lease will eventually require the erection of platforms for its development. Many tracts, about 2 of 3 offered, may never be developed. It is estimated that each full tract (5,760 or 5,000

acres) developed will average three structures per tract. Using the actual dimensions of a platform, three per tract would physically cover approximately 0.02% (1.0 to 1.15 acres) of each tract's sea floor. Taking into account a navigational safety zone around them and using the 2 to 5 acres per platform figure, trawlers may be denied up to 0.3% (15 acres) of the seafloor per developed tract.

Total number of platforms required to develop a lease area and their spacing relative to each other are important factors in considering their potential impact on commercial fishing activities. Because it is impossible to determine these factors in advance of a proposed sale, a special stipulation (see section IV., Mitigating Measures) has been suggested as a measure to be responsive to an impact that it is believed will result if careful planning and coordination are not undertaken.

2. Creation of Obstructions on the Seafloor that Cause Damage to Trawling Nets

The obstructions referred to here are underwater stubs, large pieces of debris, and unburied pipelines.

The source and nature of stubs was described in section I. F. 2. b. As already stated, Coast Guard regulations require that stubs be marked by a buoy at the surface if located in 80 feet or less of water. However, the Coast Guard has informed us that in spite of

regular maintenance and replacement, these buoys are frequently found to be missing. If a trawler pulls his net across a stub, it will certainly be badly damaged or lost.

Large pieces of debris, such as equipment, piping, structural members, tools, and the like, may accidentally be lost off a platform, service boat or barge. If this occurs off or very near a platform, it may be located easily by divers and retrieved. However, if it is lost off a boat or barge underway, the location may not be known accurately enough to allow its subsequent recovery. Depending on the size and weight of items lost in this way, varying amounts of damage may be done to trawling nets of fishermen unlucky enough to snag them.

It has also been reported 1/ that unburied pipelines (beyond the 200 foot depth contour) pose a serious problem to the shrimp trawling operations. The following statistics show that a considerable proportion of the Texas shrimp catch is harvested from deeper waters.

1/ Testimony of James C. Farrelly, President, Louisiana Shrimp Association, presented at August 23, 1972, OCS Public Hearing New Orleans, Louisiana.

Texas Shrimp Harvest by Depth 1/

Year	Depth, Feet	Species	Approximate Proportion of Total Catch
1967	126-360 126-210	Brown Pink	30%
1968	126-450 126-240	Brown White	19%
1969	126-270 126-240	Brown White	24%
1970	126-360	Brown -	24%

It can be concluded that a significant amount of shrimp trawling does occur in water depths where pipelines remain unburied. We have no information concerning the frequency, location, or severity of incidents involving trawling operations and unburied pipelines and therefore cannot assess the scope of the impact, should this proposed sale be held.

3. Contamination of Fish by Spilled Oil

Fish which are either externally coated or internally contaminated with oil are unmarketable. It has been shown that fish that live in the vicinity of chronic spillage are likely to be internally contaminated. Ehrhardt (1972) has found that oysters taken near the entrance of the Houston Ship Channel in Galveston Bay, Texas are contaminated with a high content of petroleum-derived aromatic hydrocarbons. Because aromatic hydrocarbons are much more soluble in water than paraffinic and naphthenic hydrocarbons, the oysters most likely take up the aromatic fraction as a watery solu-

1/ Computed from data presented in U. S. Fish and Wildlife Service 1968, 1970; National Marine Fisheries Service, 1971a, b.

tion through their gills and, being filter-feeders, as particulate matter. The author found the composition of the oyster contaminant to be similar to many Texas crude oils, among them Conroe, Beaver Lodge, and Lee Harrison. Connell (1971) has shown that a kerosene-like tainting in Australian mullet is due to the presence of kerosene-like hydrocarbons in the flesh. He found the contaminating compounds to be similar to substance isolated from river sediments, and that government Fish Board condemnation records show that periods of condemnation coincide with periods during which mullet have just left the estuaries and large catches are made. The river used by the mullet flows alongside oil refineries and associated storage and wharf facilities. Volatile hydrocarbons were found in the water adjacent to petroleum storage facilities and also in the river's estuary near a sewage outfall. Scarratt (1971) has found that commercial species of scallops ingested spilled Bunker C oil. Subsequent chemical analysis revealed the presence of Bunker C in the mantle, digestive gland, adductor muscle, and gonad, leading to the conclusion that the scallops had assimilated the ingested Bunker C oil.

Oyster beds have been contaminated in the past from oil spilled in the marshes, bayous, and bays in the delta region of Louisiana, but we are unaware that contaminated catches have ever been taken in the open waters of the Gulf.

In summary, the general consensus of Gulf fishermen is that underwater stubs present the greatest problem; the presence of offshore structures are a moderate inconvenience; and, the debris problem is minimal. Based on past OCS experience, we anticipate no impact to result from contamination of catches.

E. Conflict with Ship Traffic and Navigation

In seas adjacent to the United States, including the Gulf of Mexico, safety lanes, or fairways, have been established for the safe passage of vessels enroute to or from U.S. ports. However, an unknown number of ships do not use these fairways, greatly increasing the possibility for a collision with drilling rigs, permanent platforms, and their attendant vessels. Impacts which could result include loss of human life, a spill of oil, release of debris including parts of, or the entire drilling rigs, and the ship, if it sinks. The contents of the ship's cargo could pose a serious threat to the environment if it includes toxic materials such as chemicals, crude oil, or refinery products. Statistics on ship-platform collisions were given in section III. A. 2. d.

Floating trash accidentally lost off platforms also constitutes a hazard to boats. Damaging collisions can result between small fast boats and floating drums, cans, and wood. The screws of all sizes of motor boats and vessels can be fouled on floating plastic sheeting and plastic or nylon ropes. The extent of this problem is unknown.

F. Impact on Recreational, Historical and Archeological, Aesthetic, and Conservation Resources

1. Beach and Shoreline Recreation

Impacts on recreation will result from pipeline construction and could result in the event of a major oil spill.

The nature of pipeline construction and burial, especially as it effects the beach has already been discussed in sections I. F. 4. and III. B. 2. The disturbed area will be extremely small (about 30 feet wide) and could occur in up to three locations. The first high tides following burial of the pipeline will serve to restore the beach terrain. The restoration of the beach ridge will take longer, most likely requiring a storm tide or high winds to obliterate the effects of the excavation. The interference of pipeline construction with recreation will be minimal.

Water sports, such as swimming, diving, spearfishing, underwater photography, fishing for finfish and shellfish, boating and water skiing would also be directly affected by an oil spill.

Other marine related activities such as beachcombing, shell collecting painting, shoreline nature study, camping and sunbathing would be made much less attractive for an indeterminate period where an oil spill had coated a beach.

The impact of spilled oil would be the same at the state, county, and municipal parks (as listed in Attachments D and E) but the effects would be more keenly felt due to the more intense usage of these areas by the public.

2. Sport Fishing

Although we have no conclusive evidence, it is our opinion that a major oil spill would effect sport fishing adversely. Boat fishermen would not want to soil their boats by fishing in the vicinity of an oil slick and neither boat nor surf fishermen would want to keep fish that had been coated or contaminated with oil. Therefore, sport fishing would be curtailed in the vicinity and for the duration of the spill incident.

We have received extensive testimony and evidence that overall, oil and gas operations have a favorable impact on sport fishing activities. The favorable impact is the result of sports fish population enhancement due to the artificial reef effect of offshore platforms. In the open sea, offshore platforms provide both food and cover in areas that are largely devoid of those essentials. Myriad forms of microorganisms in the water drift by these structures and attach themselves, soon encrusting all exposed surfaces on the platform. The average platform in 150 feet of water provides 90,000 square feet of hard surface for encrusting organisms 1/. Hard substrate is necessary for encrust-

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1/ Information from Keith G. Hay, Conservation Director, American Petroleum Institute.

ing organisms such as barnacles, hydroids, corals, mussels, and other invertebrate organisms which serve as links in the food chain. Randall (1963) has stated that artificial reefs provide protection, food sources, spawning sites, and spatial orientation markers for fishes. The same author found that artificial reefs attract available fish from surrounding waters, and, increase the size of some populations by providing additional protected areas and food for both young and adults.

3. Aesthetic and Scenic Values

If air quality permits unlimited visibility, some portion of a one hundred foot structure can be seen from the beach if it is located 17 miles or less from shore. Some people consider the sight of offshore equipment aesthetically unpleasant. Six of the 129 tracts included in this proposal are located at distances varying from 12 to 17 miles from shore.

Any floating material such as debris or oil that is cast up on the beach or washed into a bay would constitute an impact upon the aesthetic values for users or owners of the area.

Even after burial of the pipeline, the scars will cause a considerable impact on the aesthetic values of the beach and associated dunes and sand flats. It is our estimation that the impact will

endure for at least a year, until sand has been redistributed by wind, tides, and rain, and another growing season brings about revegetation.

4. Historical or Archeological Sites and Objects

Impacts on these items could stem from two sources: during an oil spill, any objects coated with oil would obviously be rendered less useful and valuable and may not survive cleaning operations. In addition, porous items such as wood, pottery, or shell may be internally contaminated with oil and this might interfere with carbon-dating procedures.

During pipeline burial operations, sites or objects of interest may be damaged or destroyed. Normal pipeline route survey procedures usually include a magnetometer survey. In this way, all larger ferrous objects, including objects of historic or archeological value, are detected and avoided or investigated prior to actual laying operations. This survey would not reveal the presence of non-ferrous objects, however.

The potential for loss or damage is clear, but at this time, we cannot assess the scope of the impact that will result if this proposed sale is held.

5. Conservation Resources

Included under this heading are the state and Federal wildlife refuges, and wildlife management areas. A complete list is presented in Attachments D and E.

It is believed at this time that none of the refuge and management areas in the vicinity of the proposed sale will receive an impact of any kind as a result of this sale. There are no refuges or management areas bordering the beach and therefore, they could not be significantly contaminated in the event of an oil spill. None will be crossed by a pipeline. No onshore construction will take place adjacent to them.

G. Impact on Land Use and Land Use Trends

1. Potential Damage, Loss to Private Landowners

A maximum of three new pipelines are expected to come ashore as a result of this proposed sale, and all would probably be placed between East Bay and Sabine Pass. Any damage or loss to private landowners if it were to occur, from the construction or operation of pipelines and terminal facilities would occur in this area. Privately-owned land in this area is used primarily for cattle-grazing.

During the laying of pipeline and the construction of pipeline terminal facilities, if this occurs on private land, a small amount of land will be temporarily lost for grazing purposes. Pipelines onshore in this area are buried, however, and there would be no permanent loss of the land for grazing (see discussion in section III. B. 4.). The existence of a pipeline terminal facility would involve the permanent loss of a small amount (on the order of an acre) of land for grazing since there would be an access road and a permanent structure.

A pipeline leak, involving the release of oil into the grazing land may have an impact on the vegetation and water quality (as discussed in section III.) resulting in loss of grazing area. A pipeline leak involving a release of gas would have an impact on the air quality

in the area, depending on the size and duration of the leak, and would present the danger of an explosion, thereby resulting in a temporary loss of a given area for other uses.

2. Land Surface Area Required by Support Facilities, Roads, Etc.

Until the amount of production from the tracts proposed for sale is more accurately known, it is impossible to determine the number and type of additional support facilities that will be needed. Until the number and type of support facilities needed is known, it is impossible to determine the land surface area they will require. According to the testimony of E. O. Bell at the Public Hearing in Houston in February, there is a possibility that some additional gas processing plants will be required if large volumes of gas are found, but it is expected that there are enough shoreside facilities to handle the majority of the oil production that may result from the sale. 1/ However, the number, size, and location of these additional gas processing plants cannot be predicted at this time.

1/ From testimony of E. O. Bell, past president of Offshore Operators Committee, at OCS Public Hearing in Houston, Texas, February 21-22, 1973.

H. Secondary Impacts

1. Induced Industrialization in the Coastal Zone

Much of the Texas coastal zone shoreward of the proposed sale area and inland from the coastal wetlands is a highly urbanized and highly industrialized region. Since much of the industry in the area is petroleum-related, the impact of the proposed sale will not be to change the character of the industry in the area. It is probable, however, that there will be an increase in activity of some sectors of the petroleum-related industry. For example, an increased demand for exploratory rigs, production platforms, and pipeline laying equipment would result in an increase in activity in the respective industries that exist in the coastal zone to accommodate this demand.

Since only nine of the tracts proposed for leasing are oil prone, it is expected that existing refinery capacity will be able to handle this production. However, as discussed in section III. F. 2., if the volume of gas produced from tracts proposed for lease proves large enough, there may be a need for additional gas processing plants.

2. Impact on Population

The population of the highly urbanized eastern Texas area concentrated around the Houston-Galveston area and the Beaumont-Port Arthur area will not be greatly altered in terms of numbers or

distribtuion by the proposed sale. The combined population of the three SMSA's 1/ in the eastern Texas coastal zone, Houston, Galveston-Texas City, and Beaumont-Port Arthur-Orange, and Chambers County is 2,482,973 and the total labor force of this area is 1,091,600.

Exploration and production resulting from the proposed sale is not anticipated to require an influx of labor or a redistribution of population since a large petroleum-based industry is already well established in the area, and a large labor force exists with the necessary skills to meet the requirements of jobs generated by the proposed sale.

3. Economic Effects

Because only a few of the tracts to be offered in this sale are offshore Louisiana, most of the regional economic impact will occur in Texas. The Texas economy is heavily influenced by the oil and gas industry. In 1971, the state produced 35.4% of the Nation's crude oil and 21% of the natural gas. Texas currently has approximately 19% of the total U.S. refining capability.

In 1972, Texas completed an Input-Output analysis of the state economy which examined the interdependence among different sectors of the economy. The model was based on 1967 figures, since that was the most recent year for which complete information was available. In that

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1/ Standard Metropolitan Statistical Area.

year, the petroleum industry paid $1.67 billion in the form of wages, salaries, and royalties to Texas households. This was 5.4 percent of the income received in 1967. Total taxes paid by the petroleum industry in 1967 was $978.4 million or approximately 12.5 percent of taxes collected within the state. Employment directly related to producing and refining crude petroleum in 1967 was 81,844 or 2.6 percent of those employed in Texas in 1967. Based on "multipliers" developed in the model, the total economic effect of crude oil production and refining was $26.52 billion. The total income attributable to producing and refining was $5.63 billion. Total employment attributable to producing and refining was 486,000. 1/

Based on the production values given earlier ($110 to $220 million for oil production and $1.9 to $2.7 billion for the gas production), and a multiplier of 3.62, the total economic activity resulting from the production from this sale would be $7.2 to $10.4 billion. In order to estimate the effect of processing these minerals, it is assumed that all refining will be done in Texas. Based on the Texas Input-Output model, the value of the refined crude oil would be $308 to $616 million and that of the processed natural gas would be

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1/ Testimony of Dr. Herbert W. Grubb, Manager, Division of Management Science, Office of Information Service, Office of the Governor, Texas, before Public Hearing in Houston, Texas, February 21, 1973.

$3.2 to $4.5 billion. When all factors are taken into consideration "the total economic activity which could be attributed to the production of the recoverable reserves if they are processed and distributed by Texas firms ranges from $10.6 to $15.4 billion." 1/

Further estimates indicate that the annual impact of the production would be $371.0 to $538.7 million. If all processing and distribution is done by Texas firms, the total impact would be from $468.3 to $820.0 million per year.

1/ Additional information supplied on request by Dr. Grubb, March 1, 1973.

I. A Matrix Analysis of Some Possible Adverse Impacts on the Environment and Related Uses

In this section, a matrix system is introduced for the purpose of identifying and analyzing on a tract-by-tract basis those factors resulting from the proposed sale which could impact on the environment and which lend themselves to such an analysis. The matrix itself is simply a device used for displaying the interrelationships of some of the impact-producing factors (on the horizontal axis of each matrix) with coastal activities and resources which could sustain an impact (on the vertical axis of each matrix) and for assigning values to these interrelationships.

1. Purpose - The purpose is to analyze possible impacts of the proposed OCS lease sale on the environment using a matrix analytical technique in an attempt to provide the decision-maker and reviewer with an array of factors which must be considered in order to form value judgments concerning the importance of these impacts to the environment.

2. Significant Resource Factors - The matrix analysis examines major factors which could sustain negative impacts as a result of the development of the tracts included in the proposed lease sale. Significant resource factors appear on the vertical axis of each matrix and for purposes of this analysis have been identified and placed into two groups as follows:

a. Natural Resource System

Refuges/wildlife management areas 1/

Unique and highly productive areas 2/

Biota seaward of estuary/nursery areas

Beaches

b. Coastal Activities/Multiple Uses

Shipping

Recreation (boating, swimming, water oriented activities other than sport fishing)

Commercial fishing

Sport fishing

3. Impact-Producing Factors - The matrix includes two major categories of factors which can impact on significant resources (i.e., natural resource systems, and coastal activities) as a result of the development of proposed OCS oil and gas leases. The Impact-Producing Factors appear on the horizontal axis of each matrix and have been identified as follows:

a. Structures (e.g., platforms, fixed structures and artificial islands)

b. Oil spills

1/ Includes parks, sanctuaries, historical landmarks, etc.

2/ Includes marsh, estuary, nursery, and coral reef areas.

Other impact-producing factors such as debris and pipelines cannot be analyzed on a tract-by-tract basis and therefore are not included in this matrix section. However, these factors are discussed on the basis of the entire sale elsewhere in the statement.

4. Analytic Procedures - Each impact-producing factor is analyzed on the basis of (A) its potential magnitude and persistence which we have termed its importance, and (B) its proximity to high value resources or coastal activities/multiple-uses. A series of scales has been devised for the purpose of assigning a range of values consisting of importance and proximity to each impact-producing factor. These scales together with definitions and discussions are presented below.

(A) IMPORTANCE

a. Structures:

Under some conditions, structures have an adverse effect on commercial fishing activities. Depending on currents and underwater obstacles an offshore structure can remove areas of trawling and purse seining waters. Heavy concentrations of platforms can make trawling and purse seining difficult.

Oil and gas platforms pose a hazard to commercial fishing and boating in general. Directional drilling from outside shipping lanes, however, can be used to develop tracts lying partially in shipping lanes.

An estimate of the importance of the impact of structures on the environment consists of two factors: 1) quantity--in this case it is estimated that all tracts 5,000 acres or more in size will average three structures per tract, even though many tracts may never be developed, and 2) time--all structures will remain on site for an average period of 15 to 20 years.

b. Oil Spills:

The same two factors for estimating the importance of oil spills on the environment are as follows: 1) quantity--our analysis is based on all spills of 1,000 bbl. or more, and 2) time--based on past experience the oil itself may remain in contact with, or a hazard to, the environment for a period of 1 to 90 days.

A scale indicating the importance structures and oil spills pose to significant resources or coastal activitive/multiple uses follows:

SCALE OF IMPORTANCE

100	- Oil spills: complete destruction of a resource within the immediate area of a spill, impossible to remedy or control; Structures: permanent obstruction and disruption of coastal activities/multiple uses
80	- Oil spills: very hazardous to life and extremely difficult to remedy; Structures: very inconvenient interference with coastal activities/multiple uses
60	- Oil spills: hazardous to plant and animal life and costly to remedy or control; Structures: inconvenient interference with coastal activities/multiple uses
40	- Oil spills: unsightly and potentially hazardous to plant and animal life but relatively easy to remedy or control; Structures: some minor inconvenience to coastal activities/multiple uses
20	- Oil spills: unsightly; Structures: slight inconvenience
0	- No adverse effect

(i.e., rate of shoreward drift) ranging from 0.35 to 0.5 knots 1/, oil spills from a tract 5.0 nautical miles from shore or high value resource could deposit oil on that area within 10 hours, for a tract 10.0 nautical miles from shore or high value resource oil could be deposited within 20 hours, etc. The oil industry has develped a contingency plan that will enable oil containment and clean-up equipment to be brought into use within 12 hours of notification that a spill has occurred.

The proximity scale with regard to structures takes into account their potential impact on shipping and is different than that for oil spills, as shown below:

1/ This range is a generous estimate and is based on ocean current velocity data pertaining to the area under study. It must be emphasized that the 0.35 to 0.5 knots range is a calculation of the shoreward component or rate of shoreward drift of ocean current velocities in the area. Although other factors would also be important, the rate of shoreward drift is the single most important factor involved in estimating time and possible impact points from an oil spill on nearshore or onshore high value resources. The 0.35 to 0.5 knots range may be overestimated, but it was determined that when precise and definitive data are incomplete, underestimating a critical time factor would be far more misleading and critical to the integrity of the analysis than overestimating. While this range is subject to change and refinement, it is believed to be representative of what could be expected to occur in the area under study under normal conditions.

Proximity Scale (Structures)*

1.0 - Tract partially within shipping lane, anchorage area, natural resource system, or activity area

0.8 - Tract within one mile of shipping lane, anchorage area, natural resource system, or activity area

0.6 - Tract within 1.1-3 miles of shipping lane, anchorage area, natural resource system, or activity area 1/

0.4 - Tract within 3.1-6 miles of shipping lane, anchorage area, natural resource system, or activity area 2/

0.2 - Tract within 6.1-10 miles of shipping lane, anchorage area, natural resource system, or activity area

0.0 - Tract beyond 10 miles of shipping lane, anchorage area, natural resource system, or activity area

* Measurements taken from the edge of a tract to the nearest edge of a shipping lane, anchorage area, natural resource system or activity area.

1/ Tracts ranging in depth from over 90' to 210' are considered to be in an intensive commercial fishery area for only one species, such as brown shrimp. These tracts have been assigned a value of 0.6 to reflect the fact that offshore structures in these water depths will be in proximity to an intensive single species fishery.

2/ Each proposed tract not located in an intensive commercial fishing area has been assigned a value of 0.4. This value has been assigned to reflect the fact that commercial fishing activities occur throughout the Gulf and therefore, all platforms placed on the continental shelf will be in proximity to some kind of commercial fishing activity regardless of water depth or distance from shore. See section II. E. 2. b. for a description of the distribution of commercial fishing activity.

(C) RELATIVE ENVIRONMENTAL IMPACT FACTOR

A relative environmental impact factor is a product of Importance, and Proximity, and is expressed both for structures, F (St) and oil spills, F (O.S.). The equation for obtaining this factor can be exnressed simply as I x P = F (St. or O.S.).

The higher the relative environmental impact factor, the higher the potential for environmental damage. Tracts with overall high environmental indices will be singled out for additional consideration in accordance with the scale below. It is very important for the decision-maker or reviewer to keep in mind the possible synergistic and/or accumulative effects resulting from a tract having one or more categories within a high index range.

This scale of relative environmental impact factors is proposed for determining the potential damage a tract might pose to a significant resource or activity.

Relative Environmental Impact Scale

Greater than or equal to 50	Relative environmental impact factor in this range indicates that the tract should be carefully scrutinized. Depending upon the significance and character of the resource that may be affected, possibilities in the decision include: (1) Withdraw the entire tract from the proposed offering. (2) Offer only a portion of the tract. (3) Offer the tract with special stipulations included in the lease to reduce the potential for damage or hazard. (4) Offer the tract because of mitigating circumstances with or without special stipulations.
Greater than zero but less than 50	Relative environmental impact factor in this range indicates that the tract could be developed safely within existing standard practices and operating regulations without significant damage to the resource involved. Additional special stipulations in the lease would not normally be necessary.

The individual, tract-by-tract, matrices have been appended to this statement. See Attachment F. The following section presents a recapitulation of the matrices and the section following that presents a summary risk analysis.

J. Recapitulation of Matrices

1. Refuges/Management Areas -

None of the tracts in this proposed sale reflect an environmental impact factor for oil spills of over 20 in relation to refuges/management areas. Even a massive oil spill resulting from any one of the nine Galveston area tracts in this proposed sale estimated to be oil or oil and gas producing would not be expected to impact upon refuges/management areas.

None of the Galveston area tracts are closer than approximately 30 miles from any wildlife refuge. The Anahuac National Wildlife Refuge is protected from the sea by Bolivar Peninsula and the Brazoria National Wildlife Refuge is protected by the Galveston, Mud, Moody, and Folletts Islands. For oil to reach these areas it would have to first pass over the beach ridges, peninsula, or islands.

2. Unique and Highly Productive Areas (Marsh/Estuary/Nursery/Coral Reef Areas)

Galveston Area

Block No.	Miles Offshore	Water Depth	Antici. Production
190 (E 1/2)	13	50	Oil
211 (N 1/2)	14	55	Oil
212 (N 1/2)	12	55	Oil and Gas
325	28	75	"
326	27	75	"
381	20	80	"
382	23	90	"
392 (N 1/2)	24	90	"
393 (N 1/2)	22	90	"

The above list includes all of the tracts in this proposed offering which are anticipated to produce oil, or, oil and gas. All remaining tracts in this proposed sale are anticipated to be gas producers only. (See Attachment B for complete tract list.)

Galveston Area, blocks 190 (E 1/2), 211 (N 1/2) and 212 (N 1/2) show environmental impact factors of 50 for oil spills in relation to estuary/marsh/nursery areas. This is primarily a reflection of their proximity to the above resource areas and the fact that they are estimated to be oil producing tracts. A massive oil spill resulting from these three tracts could impact upon the above resources given special circumstances such as those discussed below. However, there is a possibility that an oil spill resulting from development of any one of the Galveston area tracts could reach the Texas shoreline.

The Texas bays, estuaries and marshes behind Bolivar Peninsular, Galveston Island, and coastal areas continuing southwestward are protected by a relatively high beach ridge. The only way oil could reach these inland water areas would be through Bolivar Roads (entrance to Galveston Bay) which is less than 1 1/4 nautical miles in width, through San Luis Pass which is less than 1/4 nautical mile in width or through Rollover Pass which is less than 100 yards wide. Oil spilled from blocks 190, 211, and 212 would have to travel from 14 to 16 miles due north to reach San Luis Pass. The rest of

the tracts in the Galveston Area range from 27-32 miles from San Luis Pass and from 39-56 miles from Bolivar Roads.

The only other way oil spilled from the proposed Galveston area tracts could reach inland marshes and waterways would be by extremely high tides associated with hurricanes at the time of a massive oil spill. A description of hurricanes is given in section II. B. 6.a. A hurricane tide could breach the high beachridge and propel oil into bays, estuaries, and marshes. The dispersion, dissolution, evaporation, emulsion and oxidation from precipitation, wind and wave action that would act on spilled oil during a hurricane, combined with the distance the oil would have to travel (over 12 miles at the nearest point) to pass over the beach ridge would tend to mitigate the impact.

On the basis of the above circumstances and conditions the possibility of an oil spill from this proposed sale actually impacting on marshes, bays, estuaries, and inland waterways is considered remote.

Unique to this proposed sale are two coral reef communities (i.e., East and West Flower Gardens) which are over 100 miles from shore and Stetson Bank which is approximately 80 miles from shore. One tract in this proposed sale, High Island, East Addition - South Extension, block A368 is within 3 miles of the East Flower Garden Bank. In addition, two tracts, High Island, South Addition blocks A502 and A503 include

Stetson Bank. All of these tracts are gas prone and therefore concern for oil pollution effects to the coral reefs is eliminated.

However, development of the tracts identified above must be conducted in a manner consistent with the protection and preservation of these unique reefs. A special stipulation concerning the development of these tracts has been presented in section IV.

3. <u>Biota Seaward of Estuary Nursery Areas</u>

The nine tracts in this proposed sale estimated to produce oil or oil and gas reflect an environmental impact factor of 40 for oil spills in relation to this natural resource category. Of all the categories identified in the matrix analysis, the adverse impact of an oil spill on biota in open water is the one we know the least about. Although data in this area is sparse, it is discussed in section III. B. 2. c. (2) of this statement.

4. <u>Beaches -</u>

All nine tracts estimated to produce oil in this proposed sale could impact on beaches in the event of a major oil spill. However, there are no tracts in this proposed sale which have an environmental impact factor of over 40 for oil spills in relation to beaches.

5. <u>Shipping -</u>

High Island, blocks 92, 110, 111, 142, and 154 (N 1/2); High Island, South Addition, blocks A482, A532, A556, and A563; and

West Cameron, South Addition, block 528 each have environmental impact factors of 80 for structures in relation to shipping. This is a reflection of the fact that each of these tracts are partially within shipping lanes or anchorage areas. Development of these tracts would be subject to Federal Regulations as described in section IV. B.

There are also three blocks which have an environmental impact factor of 64 for structures in relation to shipping: Galveston, block 381, and High Island - South Addition, blocks A481, and A483. These tracts are within 1 mile of established shipping fairways. In addition, there are a total of 34 tracts that range from 1.1 to 10 miles from shipping fairways or anchorage areas (environmental impact factors of 16 to 48). All remaining tracts in this proposed offering are over 10 miles from shipping lanes or anchorage areas.

6. <u>Outdoor Recreation -</u>

There are no tracts in this proposed sale which reflect an environmental impact factor of 50 or more under either structures or oil spills for this category.

7. <u>Commercial Fishing -</u>

The nine tracts identified for oil or oil and gas production each reflect environmental impact factors of 80 regarding oil

spills and structures in relation to commercial fishing. In addition, a total of eight gas tracts (High Island, blocks 92, 110, 111, 141, 142, 154, and 200; and, High Island - East Addition, block 46) each reflect an environmental impact factor of 80 for structures in relation to commercial fishing.

The above 17 proposed tracts are located within an area identified in section II. E. 2. (see especially Fig. 36) as a major commercial fishing zone. Accordingly, these tracts should be carefully scrutinized as part of the decision-making process.

A suggested stipulation concerning the development of all the tracts in this proposed sale has been presented in section IV. B. If adopted, this stipulation would help mitigate the impact resulting from the placement of structures in relation to commercial fishing activities. However, the potential adverse impact on commercial fishing activities and commercial fish species resulting from oil spills cannot be mitigated by a special stipulation.

8. Sport Fishing -

Each of the nine tracts in this proposed sale estimated for oil production show an environmental impact factor of 80 for oil spills in relation to sport fishing. This is a result of the proximity of these tracts to sport fishing areas and a reflection of the fact that the tracts involved are estimated oil producers.

In every case, the environmental impact factor of structures for sport fishing is fixed at a zero. This reflects the fact that offshore structures have a favorable impact on sport fishing activities by concentrating fish around the platforms and thereby increasing the average catch. Most of the sport fishing from platforms is undertaken within 30 miles from shore, although some sport fishing craft make overnight trips and can venture out much further. Offshore platforms also serve as aids to navigation, a source of assistance in emergencies and havens for small boats in storms. Platforms resulting from blocks leased as a result of this proposed sale could be expected to have a positive and favorable impact on sport fishing and small boat recreationists over a long period of time (at least 20 years).

K. Summary Risk Analysis

Three risk categories will be used to rank the degree of potential hazard the tracts in this proposed sale pose to the environment. These categories are discussed below:

1. High Hazard Potential to the Environment

Highly hazardous may be defined as a tract which is oil or oil and gas prone and within such close proximity to a high value-critically vulnerable resource as to disallow the minimum present practical response time 1/ necessary to effectuate oil spill containment, clean-up and contingency measures to stop or retard the spill from impacting upon the resource. Also, a tract may be considered highly hazardous if it is oil prone and is wholly located in an unstable sediment zone. No tracts in this proposed sale are considered to be highly hazardous to the environment.

2. Moderate Hazard Potential to the Environment

Moderately hazardous may be defined as an oil or oil and gas prone tract whose proximity to a high value-critically vulnerable resource does not preclude adequate response time (based on current industry capability in the Gulf of Mexico, offshore Louisiana and Texas) necessary to effectuate containment, clean-up and contingency measures to stop or retard the spill from impacting upon the unique

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1/ Minimum practical response time would be 12 to 18 hours from the time a spill occurred to the time appropriate equipment can be at the spill site.

resource area. However, all oil prone tracts, if not determined to be highly hazardous to the environment, are placed in this category for primarily two reasons: (a) all are capable of spilling oil; the effects of an oil spill on open ocean marine biota is also considered adverse although not as severe as the effects on unique (usually nearshore or onshore) high value resources; (b) no clean-up and containment equipment can be effectuated during adverse weather conditions, such as violent storms and hurricanes and none of this type of equipment available today is very effective in five-foot or more seas.

In this proposed offering there are 9 tracts considered to be moderately hazardous to the environment. These tracts are Galveston Area, blocks 190, 211, 212, 325, 326, 381, 382, 392 and 393. Three of these tracts (blocks 190, 211, and 212) range from 12 to 14 miles from shore and in the event of a spill from any one of these three tracts, the response time necessary to stop oil from reaching Galveston Island beaches would be critical. Under normal conditions, an oil spill from any one of these three tracts would allow a response time ranging from 24 to 28 hours (computed at a highly liberal estimate of 0.5 knot per hour shoreward increment of ocean current velocities in the area) from the time a spill occurred

to the time it would take to reach the beaches. The Clean Gulf Associates (see Section IV, Mitigating Measures) has indicated that their oil containment and clean-up equipment can be on the scene of a spill within 12 hours of notification that a spill has occurred. The effectiveness of this operation of course, would be dependent upon attendant weather conditions and sea state at the time of a spill.

3. Minimal Hazard Potential to the Environment

Minimally hazardous may be defined as a gas prone tract whose development under existing operating orders, regulations and safety requirements promises a low level of disruption and adverse effects to the environment. Experience indicates that the impacts resulting from development of tracts of this type are not so much ecological in nature as they are conflictual with other uses or activities in a marine area. In most cases, such conflicts or hazards can be mitigated by enforcement of existing regulations or by attaching special conditions or stipulations to the lease concerning its development.

In this proposed sale, all of the tracts (120 in all) in the following lease areas are considered to be minimally hazardous to the environment:

Galveston - South Addition

High Island - South Addition

High Island - East Addition

High Island - East Addition - South Extension

West Cameron - South Addition

East Cameron - South Addition

This conclusion is based on the following factors: a) all are gas prone tracts; b) approximately 94% of the tracts are over 55 miles from shore, thus reducing to some degree the conflict of structures to recreational boating and commercial fishing activities; c) none of the tracts are located in unstable sediment zones; d) conflicts with other uses and activities of the area and any threats to the protection and preservation of unique coral reefs will be mitigated by regulations, operating orders, and where necessary, special stipulations. For discussion of effects on coral reefs see Section III. and for stipulations concerning development of tracts in close proximity to coral reefs see Section IV.

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IV. MITIGATING MEASURES INCLUDED IN THE PROPOSED ACTION

The Department has developed the following strategy for safe development of the mineral resources of the OCS.

Management of the mineral resources of the OCS will be conducted in such a manner as to cause these resources to make a significant contribution toward supporting the present and future national economy at a rate consistent with maximum possible protection of the environment, orderly and timely development of the resource, and receipt of a fair market value return to the Federal Government.

Reasonably safe development of oil and gas resources on the OCS can be achieved through strict enforcement of lease stipulations and obligations, (detailed in the OCS operating regulations and orders) 1/ and must be based on sound operating practices backed by effective contingency actions in the event that pollution occurs as a result of a natural disaster, human error, or equipment failure.

Research and development programs in exploration, production, transportation, containment and clean-up technology, which provide greater safeguards for the environment, are being conducted by the Department of the Interior, other Federal agencies and

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1/ OCS operating orders for the Gulf of Mexico have been appended to this statement. See Attachment G.

private industry. The Coast Guard in fiscal year 1972 spent in excess of $3,000,000 for research and development on oil containment booms, oil recovery devices and techniques for forecasting movement of oil slicks. The oil industry during the period 1966-72 has reportedly committed nearly $235,000,000 for environmental research and development on air and water pollution. Currently the American Petroleum Institute (API) and the USGS have a cooperative effort underway which will document research work on safety and anti-pollution equipment, recommend additional research, and supervise the management of additional safety or anti-pollution research projects funded by API. As advances are made, OCS operating regulations and orders will be revised and the new technology applied to existing leases as well as new leases. Revisions of the regulations and formulation of lease stipulations may also result from the review of environmental impact statements by the agencies and the interested public.

The following discussion concerns the mitigatory measures which will influence any possible adverse impacts that could result from this proposed sale. These measures are presented as they relate to oil spills, offshore structures and pipelines as well as other impact-producing activities associated with OCS oil and gas development.

A. Oil Spills

1. Regulations

Regulations governing OCS oil and gas lease operations in the Gulf of Mexico are contained in Title 30, Code of Federal Regulations and OCS Orders Nos. 1-4, 6, 7, dated August 28, 1969, No. 5, dated June 5, 1972, Nos. 8-9, dated October 20, 1970, No. 11, dated April 5, 1972, and No. 12, dated August 13, 1971. (See Attachment G). Leasing regulations are contained in Title 43, Code of Federal Regulations. The regulations established procedures and requirements to be followed in all stages of lease operations: exploration and development, drilling, production, transportation (pipeline construction and operation) and abandonment.

A general description of operating requirements under the existing regulations follows:

a. Plans: Operating plans must be submitted by the operators and approved by the Geological Survey (GS) before each stage of operations is initiated (exploration, development, abandonment). Approval of all operations must be obtained prior to their commencement.

b. Operator Inspection and Testing: The operator is required to inspect all aspects of the safety systems at specific intervals, e.g., daily pollution inspection on manned facilities, "frequent" inspection on unmanned facilities, monthly test of check valves. Detailed records of inspections and tests are required.

c. Reports: The operator is required to report all spills or leakage of oil to GS without delay. He is also required to notify GS of any unusual condition, problem or malfunction within 24 hours. 1/

d. Safety Devices: Required safety devices include subsurface safety devices, high-low pressure shut-in controls, high liquid level shut-in controls, pressure relief valves, automatic fail-close valves at the well head, automatic fire fighting systems, automatic gas detector and alarm systems, and other safety devices on production equipment; high-low pressure sensing devices and automatic shut-in valves on pipelines; and blowout preventers, related well control equipment, and mud system monitoring equipment on drilling wells.

e. Waste Disposal: The lessee is prohibited from disposing into the ocean any oil (except that oil in produced waste water must average no more than 50 ppm) 2/, untreated waste material or other materials which may be harmful to aquatic life or wildlife. Any drilling mud which may contain toxic substance must

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1/ 30 CFR 250.45

2/ OCS Order No. 8 (2.A.(5), Gulf of Mexico, Attachment G.

be neutralized before it can be disposed of in the ocean. Drill cuttings and sand must be processed, and oil removed, before they can be disposed of in the ocean.

f. Site Clearance: When an installation is no longer needed for development of the lease, the well is plugged with cement and all casings and piling must be severed and removed to at least 15 feet below the ocean floor and the location must be dragged to clear the site of any obstruction.

g. Debris: Regulations and OCS Orders prohibit the disposal of debris into the Gulf of Mexico. Solid waste must be either incinerated or transported to shore for disposal in accordance with applicable requirements under State and Federal law.

h. Contingency Plans and Equipment: The operator is required to have an approved plan for controlling and removing pollution which provides for

(1) Standby pollution control equipment, including containment booms, skimming apparatus, and approved chemical dispersants immediately available to the operator at a land based location.

(2) Regular inspection and maintenance of such equipment.

The Oil and Hazardous Substances Pollution Contingency Plan, Gulf Coast Region, is operative and has recently been revised and updated to agree with the National Plan 1/. In addition, the Coast Guard is establishing the Gulf Coast Team of the National Strike Force (NSF) at the NASA Mississippi Test Facility, Bay St. Louis, Mississippi for the purpose of responding to oil spills in the Gulf of Mexico. The National Strike Force has been established in accordance with the Federal Water Pollution Control Act and the National Oil and Hazardous Substances Contingency Plan.

The Gulf Coast Team is fully operative at this time and presently consists of 7 men with plans to increase to a total of 13 men in the near future. This team is capable of responding to incidents within 4 hours of notification by the appropriate District Commander.

2. Inspection

Evidence of compliance with the regulations and lease requirements is obtained through surveillance of the operations under the lease and enforcement of specific requirements. The inspection system

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1/ See also IV.A.4.b. of this statement and discussion of the National Oil and Hazardous Substances Pollution Contingency Plan.

of the Geological Survey includes: (1) review and approval of plans before each operating stage is initiated, (2) close review and follow-up as necessary, by GS inspectors, of all reports required of the operator by the regulations and orders, (3) on-site inspection and (4) aerial monitoring through the use of helicopters (operators are also required to inform each other of oil spills or other irregularities which they observe).

a. Operator reports: A comprehensive reporting system covering all oil spills and any unusual conditions (for example: reporting and investigation of a persistent oil slick from an unknown source such as a sunken ship or natural oil seep) is required by the orders and is a key factor in monitoring operations. Operators are also required to maintain records for GS inspection of required periodic tests of safety equipment. Compliance with reporting requirements can be assured only by periodic on-the-site inspection and aerial monitoring.

b. On-site Inspection: During the course of drilling, all operations are inspected at least one time. Leases in certain areas or in a particular development stage may require more inspections to assure the achievement of safety objectives. GS is continuing the systematic inspection program and a more stringent enforcement policy. This has resulted in increased

operator compliance along with greater coverage of production operations and better documentation of inspection results.

A program of intensive inspections is used on OCS leases. Periodically, all available inspectors devote a week to a special inspection, whereupon production platforms and drilling wells are inspected on a random basis; inspections during other periods are conducted on a regular basis with emphasis on operations believed to require special attention. The GS inspector force in the Gulf of Mexico has increased from 7 technicians and 5 engineers as of July 1, 1969 to 30 technicians and 5 engineers as of September 1, 1972. During the period January 1, 1972 to November 1, 1972, these technicians spent 2,978 inspection days or 28,169 man-hours, and engineers 319 inspection days or 2,463 man-hours in the field. Detailed inspections were conducted on 1,051 major producing platforms in the Gulf of Mexico from January through November, 1972. Also during this time period 691 inspections of single wells or satellites were made by boat. Approximately fifty percent of these inspections were unannounced. Included in these inspections were 10,714 well completions. Also, during this period, 1,054 inspections of drilling rigs were conducted. As of October 31, 1972, there were 9,149 completions capable of producing oil and

gas on OCS lands offshore Louisiana and Texas 1/. Approximately 70 drilling rigs are operating in Gulf of Mexico OCS waters at this time.

c. Aerial Monitoring: "Fly-overs" of the OCS operating areas are programmed on a seven day per week basis by GS inspectors. Any indications of oil pollution or other non-compliance will be followed immediately by an on-site inspection.

During the period January 1 through December 31, 1972, 1,389 pollution surveillance flights were made. The six helicopters chartered by the Geological Survey for use of the inspecting personnel flew a total of 6,023 hours.

3. Enforcement

The enforcement policy is intended to: (1) reduce the frequency of non-compliance with lease requirements which may lead to loss of life, loss of property, or damage to the environment; and (2) maintain a uniform enforcement policy to be applied to all operations affecting OCS lands in the Gulf of Mexico. When, in the course of an inspection, a requirement pertaining to the prevention of oil pollution or any other safety hazard is found to be in non-compliance, the operation will be shut-in until it is brought into compliance. After a shut-in, the operation can only be resumed by authorization

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1/ This figure does not include service completions.

of the GS; in all cases, this requires reinspection or a waiver of the inspection requirement. Minor incidents of non-compliance may require only a warning that corrections be made within a week. The operation will be shut-in if the required corrections are not made.

Additional penalties for non-compliance are specified in P.L. 83-212, Outer Continental Shelf Lands Act, Sec. 5(a)(2). "Any person who knowingly and willfully violates any rule or regulation prescribed by the Secretary for the prevention of waste, the conservation of the natural resources, or the protection of correlative rights shall be deemed guilty of a misdemeanor and punishable by a fine of not more than $2,000 or by imprisonment, and each day of violation shall be deemed to be a separate offense." Also Sec. 5(b)(1) and (2) provide for cancellation of nonproducing and producing leases by notice subject to judicial review or appropriate judicial proceedings.

The following table indicates the number of inspections and enforcement actions taken during two separate periods. Minor incidents of non-compliance result in formal warnings while incidents of non-compliance of a potentially more hazardous nature result in well or platform shut-ins until the operation is in full compliance with regulations and orders.

The next table indicates specific items found to be in non-compliance during ten special inspections conducted over a 14-month period.

Basic pollution control items of production equipment in which malfunctions were detected during the following comparable time periods are as follows:

EQUIPMENT MALFUNCTION DETECTED DURING JANUARY THROUGH NOVEMBER, 1971 SPECIAL INSPECTIONS

	No. Checked	Operable	Inoperable or not within acceptable tolerances	Percent Failure
Surface Safety valves	2392	2306	86	3.6%
Flowline sensors	4166	4081	85	2.0%
Check Valves	2222	2052	170	7.7%
Pressure vessels				
High pressure sensors	908	875	33	3.6%
Low pressure sensors	765	744	21	2.8%
Low level shut-in	511	481	30	5.9%
High level shut-in	460	439	21	4.6%
Total	11,424	10,978	446	3.9%

EQUIPMENT MALFUNCTION DETECTED DURING JANUARY THROUGH NOVEMBER 1972 SPECIAL INSPECTION

	No. Checked	Operable	Inoperable or not within acceptable tolerances	Percent Failure
Surface Safety valves	1533	1480	53	3.5%
Flowline sensors	3021	2982	39	1.3%
Check valves	1434	1370	64	4.5%
Pressure Vessels				
High pressure sensors	961	942	19	2.0%
Low pressure sensors	610	600	10	1.6%
High level shut-in	351	345	6	1.7%
Low level shut-in	323	314	9	2.8%
Total	8,233	8,033	200	2.4%

Companies fined in District Court for failure to install subsurface safety devices in offshore oil wells during 1970 in the Gulf of Mexico are presented below. Each company entered a plea of nolo contendere. The maximum fine for violation of the Outer Continental Shelf Lands Act is $2,000 per count.

Chevron Oil Company	$1,000,000
Gulf Oil Company	250,000
Tenneco	32,000
Kerr-McGee	20,000
Mobil	150,000
Continental	242,000
Humble	300,000
Shell	340,000
Union of California	24,000
	$2,358,000

No data for direct comparison of pollution incidences for similar time periods before and after the current "more stringent enforcement policy" are available. However, experienced personnel, private and government, are aware that after public attention was focused on the oil spill at Santa Barbara in January 1969, there has been a great deal less oil pollution in the Gulf from normal oil and gas producing operations. The public awareness, concern, and demand to prevent pollution has been a major factor in the reduction of oil spills.

In the past, major events were catalogued, but less serious events were often not reported. Occasionally, some years ago,

wells were even intentionally flowed into the water for short periods during clean-up operations. Now, sophisticated burning devices are designed to consume this well clean-up oil without air or water pollution. More automatic equipment is now in use to shut-in production whenever a leak occurs in pipeline or production facilities. These include but are not limited to pressure sensors and high and low level controls. Drip pans are placed under valves, vessels, and the production system to prevent leaking oil from escaping into the waters of the Gulf.

New reporting and investigative procedures established in the last two years have increased many fold the number of pollution incidents reported as well as the time spent by GS personnel in surveillance flights by helicopters in assuring proper documentation of pollution events.

4. Contingency Action

Oil spills will occasionally occur as a result of natural disasters, equipment failure or human error. In the event that such an emergency occurs, the following action will be taken:

a. Requirements of OCS Order No. 7 1/

In the case of any spill, the operator is required to initiate action to control and remove the oil pollution in accordance with his approved emergency plan. In any case, a spill or leakage of less than 15 bbls. requires a report from the operator as to the nature of the spill or leakage, why it occurred and what steps were taken to correct it. A spill of 15-20 bbls. must be reported by telephone immediately to GS and confirmed in writing. A spill of over 50 bbls, or one of any magnitude that cannot be immediately controlled, must be reported immediately to the Coast Guard and the Environmental Protection Agency as well as to GS.

b. Regional or National Contigency Plans

If the operator should be unable to control and remove the pollution, the Regional or National Oil and Hazardous

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1/ See Attachment G.

Substances Pollution Contingency Plan may be activated and the designated Federal On Scene Coordinator would direct control and clean-up operations at the operator's expense. This has never been necessary in the case of any spill from OCS operations to date.

The Regional or National Oil and Hazardous Substances Pollution Contingency Plan was developed pursuant to the provisions of the Federal Water Pollution Control Act as amended (33 U.S.C. 1101). Section 11(c)(2) of that statute authorizes the President, within sixty days after the section becomes effective, to prepare and publish such a Plan. The Plan provides for efficient, coordinated, and effective action to minimize damage from oil (and other) discharges, including containment, dispersal, and removal. The Plan includes (a) assignment of duties and responsibilities, (b) identification, procurement, maintenance and storage of equipment and supplies, (c) establishment of a strike force and emergency task forces, (d) a system of surveillance and notice, (e) establishment of a national center to coordinate response operations, (f) procedures and techniques to be employed in identifying, containing, dispersing and removing oil, and (g) a schedule identifying dispersants and other chemicals that may be used in carrying out the Plan, the waters in which they may be used, and quantities which may be safely used. The Plan is revised

from time to time as necessary. Operation of the National Contingency Plan requires a nationwide net of regional contingency plans. Guidelines for that nationwide net are established in the National Plan. This plan provides for a pattern of coordinated and integrated responses to pollution spills by departments and agencies of the Federal government. It establishes a national response team and provides guidelines for the establishment of regional contingency plans and response teams. The Plan also promotes the coordination and direction of Federal, State, and local response systems and encourages the development of local government and private capabilities to handle such pollution spills.

The objectives of the Plan are: to develop appropriate preventive and preparedness measures and effective systems for discovering and reporting the existence of a pollution spill; to institute promptly, measures to restrict further spread of the pollutant; to assure that the public health, welfare, and natural resources are provided adequate protection; to provide for the application of techniques to clean-up and dispose of the collected pollutants; to provide for a scientific response to spills as appropriate; to provide strike forces of trained personnel and adequate equipment to polluting spills; to institute actions to recover clean-up

cost; and, to effect enforcement of existing Federal statutes and regulations issued thereunder. Detailed guidance toward the accomplishment of these objectives is contained in the basic Plan, the annexed, and the regional plans.

The plan is effective for all United States navigable waters including inland rivers, Great Lakes, coastal territorial waters, and the contiguous zone and high seas beyond this zone where a threat exists to United States waters, shoreface, or shelf-bottom. Its provisions are applicable to all federal agencies.

A memorandum of understanding between the Departments of the Interior and Transportation outlines the respective responsibilities of the Geological Survey and the Coast Guard under the National Contingency Plan. The GS is responsible for the coordination and direction of measures to abate the source of pollution when the source is an oil, gas, or sulphur well. This responsibility includes the authority to determine whether pollution control operations within a 500 meter radius of the pollution source should be suspended to facilitate measures to abate the source of pollution. The Coast Guard is responsible for coordination and direction of measures to contain and remove pollutants, and shall furnish or provide for the On Scene Coordinator with authority and responsibilities as provided by the National Contingency Plan.

c. Petroleum Industry Contingency Actions

(i) Inventory of Known Resources Available for Emergency Oil Spill Control and Clean-up

From the upper Texas coast to the Mississippi Delta region offshore operators maintain a large inventory of various kinds of equipment that could be put to use on short notice for containing and cleaning up an oil spill and killing the source of the spill. This inventory includes 177 boats ranging from 30 foot crewboats to 165 foot utility and cargo vessels, 64 helicopters, 103 fixed-wing aircraft, over 52,600 feet of spill containment booms, and 103 pieces of skimmers and vacuum equipment. 1/ The distribution of these items is shown in Attachment H.

(ii) Clean Gulf Associates

Clean Gulf Associates is a non-profit organization formed by thirty-three companies 2/ operating in the OCS. Their purpose is to provide for a stock pile of oil spill containment and clean-up materials for use by member companies in offshore and estuarine areas. Clean Gulf Associates has contracted, effective August 1, 1972, with Halliburton Services to supply equipment, materials and personnel necessary to contain

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1/ Census of equipment made in September, 1971.

2/ These thirty-three member companies produce 98% of offshore petroleum.

and clean-up spills in the Gulf of Mexico to the limits of the OCS lying offshore and seaward of the States of Texas, Louisiana, Mississippi, Alabama, and Florida.

All of the tracts considered in this proposed lease sale fall within this area. Before any drilling commences, should this proposed sale be held, an inventory of pollution combatting equipment would be stockpiled at a strategic location. Should oil reservoirs be found and production ensue, a permanent base for containment and clean-up equipment will be established.

At the present time, Halliburton maintains four types of recovery/clean-up systems for development at two primary bases located at Intercoastal City, and Grand Isle, Louisiana, and a sub-base at Venice, Louisiana and include:

(1) Fast response open sea/bay skimmer system

(2) High volume open sea skimmer system

(3) Shallow water skimmer system

(4) Auxiliary shallow water and beach clean-up equipment.

B. Structures

If a ship strays from established fairways, oil and gas platforms can pose a hazard to commercial shipping. This hazard, however, is minimized by the fact that fairways are clearly designated on navigation charts. Direction drilling from outside shipping lanes is used to develop tracts lying partially in shipping lanes. Pertinent portions of the Federal Regulations (33 CFR Sec. 209.135(b), 1971), governing shipping fairways and anchorage areas are as follows:

> "The Department of the Army will grant no permits for the erection of structures in the area designated as fairways, since structures located therein would constitute obstructions to navigation. The Department of the Army will grant permits for the erection of structures within an area designated as an anchorage areas, but the number of structures will be limited by spacing as follows: The center of a structure to be erected shall be not less than two (2) nautical miles from the center of any existing structures In a drilling or production complex, associated structures shall be as close together as practicable having the consideration for the safety factors involved. A complex of associated structures, when connected by walkways, shall be considered one structure for the purposes of spacing. A vessel fixed in place by moorings and used in conjunction with the associated structures of a drilling or production complex, shall be considered an attendant vessel and its extent shall include its moorings. When a drilling or production complex includes an attendant vessel and the complex extends more than five hundred (500) yards from the center of the complex, a structure to be erected shall be not closer than two (2) nautical miles from the near outer limit of the complex. An underwater completion installation in an anchorage area shall be considered a structure and shall be marked with a lighted buoy as approved by the United States Coast Guard."

Development of the 10 blocks in this proposed sale which lie totally or partially within shipping fairways or anchorage areas would be subject to Federal regulations as presented above so far as placement of structures is concerned and this would help mitigate any potential impact due to the proximity of structures to relatively high frequency sea traffic.

Commercial vessels are required to report to the Coast Guard whenevery a casualty results in any of the following: (a) actual physical damage to property in excess of $1500, (b) material damage affecting the seaworthyness or efficiency of a vessel, (c) stranding or grounding, (d) loss of life, (e) injury causing any person to remain incapacitated for a period in excess of 72 hours; except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty. Drilling and production platforms (artifical islands) are required to report to the Coast Guard when involved in a casualty or accident and if any of the following occur: (a) if hit by a vessel and damage to property exceeds $1500, (b) damage to fixed structure exceeds $25,000, (c) material damage affecting usefulness of lifesaving or firefighting equipment, or (d) loss of life.

Under some conditions, offshore structures are an obstacle to commercial fishing activities. Depending on currents and underwater obstacles an offshore structure can remove areas of trawling and purse seining waters. Heavy concentrations of platforms can make trawling and purse seining difficult.

The erection of more structures on the OCS may affect commercial fishing operations. The impact from platforms may be kept to a minimum, however, by only allowing those structures necessary for proper development and production of the mineral resources, and by placing them with due regard to fishing operations and other competing uses which are evident at the time of platform approval.

The Area Oil and Gas Supervisor considers the views of commercial fishing organizations such as the Gulf State Marine Fisheries Committee with regard to placement of platforms. The Supervisor also from time to time requests information from the Department of Commerce, National Oceanic and Atmospheric Administration, and National Marine Fisheries Service to be used in his decision-making process of approving or disapproving platform installation. Within the constraints of location of the reservoirs and the technology necessary to drill directional wells, the Supervisor is mindful that platform location is an important consideration for commercial fisheries and does make decisions to minimize the impact of platform location on the commercial fishing industry.

In an effort to further mitigate the impact of offshore structures resulting from this proposed sale with regard to commercial fishing and other significant existing or future uses of the leased area it is proposed that the following lease stipulation be applied to all blocks in this proposed offering in the event they sould be leased:

"Structures for drilling or production shall be kept to the minimum necessary for the proper exploration, development, and production of this leased area, and to the greatest extent consistent with the proper exploration, development, and production of this leased area, shall be placed so as not to interfere with other significant uses of the leased area, including commercial fishing. To this end, no structure for drilling or production may be erected within the leased area until the Area Supervisor, Geological Survey, has found that the structure is necessary, on the basis of existing geological and engineering data, for the proper exploration, development, and production of the leased area. The lessee's exploratory and development plans, filed under 30 CFR 250.34, shall identify the anticipated placement and grouping of necessary structures, showing how such placement and grouping will have the minimum practicable effect on other significant uses of the leased area, including commercial fishing."

C. Pipelines

The potential impacts of each specific nearshore and coastal pipeline construction project are considered by the Department in its review of Corps of Engineers permit applications.

Although the environmental statement suggests a possible need for three pipelines in order to develop the tracts proposed in this sale, this is at best only a general estimate with only a general predetermination possible concerning location. 1/

Data concerning the miles and sizes of pipes needed, proposed routes, amount of dredging anticipated, cannot be determined until such time as the exact locations of production have been delineated. The Department will conduct an environmental analysis on any application for a pipeline right-of-way that it received. If it is determined that a pipeline right-of-way will have a major impact on the marine or coastal environment then an environmental statement will be prepared.

The adverse effects associated with pipeline installation can be substantially reduced with adequate planning and by using the most appropriate construction techniques. For example,

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1/ See section III. B. 3. for expected general location of pipelines.

pipeline corridors or existing pipeline canals can be used whenever possible so that adverse impacts are restricted to fewer locations. Where possible, pipelines can come ashore on elevated terrain to minimize damage to marshlands. Usually bulkheads are placed in canals to prevent salt-water intrusion and to maintain existing drainage and water-exchange routes. To protect oysters, pipelines are usually routed around major oyster reefs, and where shallow estuaries are to be crossed, the canal is usually backfilled; in many cases so are canals through marshlands. Although all of these measures help to mitigate the problem, the impact of pipeline installation on the coastal environment requires the joint effort of many agencies and authorities for successful resolution.

Agencies having responsibility or jurisdiction over all or part of oil and gas pipeline installation or operation in coastal areas are: (1) Department of the Interior, (a) Bureau of Land Management--rights-of-way for common carrier pipelines on the OCS, (b) Geological Survey--jurisdiction over producer owned gathering lines and flow-lines on the OCS, (c) Bureau of Sport Fisheries and Wildlife--protection of fish and wildlife resources and their habitat through consultation with the Corps of Engineers in the process of issuing Federal permits in navigable waters;

(2) U.S. Army of Corps of Engineers--issues permits for construction (including pipelines) on OCS and in other navigable waters; (3) Federal Power Commission--grants certificates of convenience and necessity prior to construction of interstate natural gas pipelines; (4) Interstate Commerce Commission--grants approval of the tariff rates for transportation of oil by common-carrier pipelines; (5) State of Louisiana--grants rights-of-way through navigable waters under State jurisdiction; (6) Department of Transportation, Office of Pipeline Safety--establishes standards for pipeline construction, operation and maintenance; and (7) Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service--protection of marine fishery resources and their habitat (in coordination with the Bureau of Sport Fisheries and Wildlife), through consultation with the Corps of Engineers in the process of issuing Federal permits in navigable waters.

At present the cooperative effort between the Department of the Interior, and the Corps of Engineers, and the National Marine Fisheries Service and State conservation agencies is responsible for minimizing the impact of pipeline (and other) construction in navigable waters of the United States. The Corps of Engineers, through authority of the Rivers and Harbors Act of 1899, (33 U.S.C. 403) asserts authority over, and requires a permit for

construction in all navigable waters subject to the Submerged Lands Act (43 U.S.C. §1301) and includes all lands permanently or periodically covered by tidal waters up to the line of mean high tide.

The Environmental Protection Agency reviews and comments on dredging projects in navigable waters in accordance with a memorandum of understanding with the Corps of Engineers, dated July 13, 1967.

The National Oceanic and Atmospheric Administration (through its National Marine Fisheries Service) has been vested with responsibility for participation in matters relating to marine and estuarine areas.

The Department of the Interior and its Bureau of Sport Fisheries and Wildlife has responsibility and authority under several statutes, including the Fish and Wildlife Act of 1956, the Estuary Protection Act, the Endangered Species Conservation Act, the Migratory Bird Conservation Act, the Fish and Wildlife Coordination Act, the Marine Mammals Protection Act, and various international treaties enacted to preserve, conserve, protect and enhance fish and wildlife resources and their habitat.

The Bureau of Sport Fisheries and Wildlife, with assistance from appropriate State and Federal agencies, including the National

Marine Fisheries Service now reviews all applications to the Corps of Engineers for permits to construct pipelines in navigable waters and assesses their potential impact on fish and wildlife resources and the environment. When appropriate, the Bureau recommends to the Corps specific modification of project plans which are needed to reduce impact on these resources. Occasionally a project plan is so conceived that significant impact cannot be avoided, but at the same time, a satisfactory alternative may be available; in such cases, a recommendation that the permit not be issued would be appropriate. At least one court decision has indicated that the Corps of Engineers has the authority under the Rivers and Harbors Act to condition or deny a permit on the basis of environmental considerations. 1/

Much of Louisiana and Texas marshlands outside of wildlife refuges are privately owned but those that are below the line of mean high tide are subject to Federal regulation (as navigable waters) through application of the Corps of Engineers permit system. Significantly large areas of Louisiana privately owned marshlands are below mean high tide and are interested with waterways or adjoin open tidal waters. Most of the major private marshland owners require that

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1/ See Zabel v. Tabb, 430 F. 2n 199 (5th Cir. 1970).

certain protective stipulations must be met or construction methods employed before granting rights-of-way for a pipeline across their property.

Thus, Federal or state 1/ authorities or private marshland owners may require, depending upon circumstances and location, that a pipelines be buried, that canals be backfilled where possible, that bulkheads be erected to prevent saltwater intrusion, the kind of dredging equipment to be used, the inclusion of shut-off valves, specific placement or disposal of spoil, or, in the case of a private landowner, that pipeline corridors be established.

The Bureau of Land Management has initiated a study to investigate the extent and character of damage to coastal resources from pipeline construction. This is a first priority project of the new environmental asessment team stationed in New Orleans. A preliminary report 2/, assessing the impact of the various phases of pipeline construction on coastal resources in the eastern Texas coastal zone, has been completed.

1/ The State of Louisiana, by Act 35 of 1971, (LSA, R.S., 51:1362), created the Louisiana Advisory Commission on Coastal and Marine Resources. This Commission is composed of representatives from the fishing, petroleum and transportation industries as well as the State Government, labor unions, and private conservation and recreation groups

2/ Bureau of Land Management, New Orleans OCS Office, 1973, Preliminary Environmental Assessment and Impact Analysis of Potential Gas and Oil Pipeline Construction in the Galveston-Sabine Pass Area, Texas, U.S. Dept. Interior.

The second phase, or longer term portion of the study, will attempt to develop criteria for pipeline system planning for application in OCS areas which have not been subjected to extensive mineral development. High priority will be given to developing criteria for the protection of bottom and shoreline resources in this study.

In addition, an interagency study is being initiated to explore the feasibility of pipeline corridors on the OCS and in coastal marshes.

Private industry has also initiated a study of pipeline effects in marsh areas. The Offshore Pipeline Committee 1/ contracted with Battelle Laboratories to conduct a systematic, comprehensive study of the environmental effects of gas pipeline construction and operation in the Gulf Coast region with emphasis on the Louisiana marshlands. The study, which is now complete, is an attempt to document existing knowledge on environmental effects of pipeline construction and operation, to identify gaps in existing data, and to state conclusions, based on present knowledge, concerning the impact of pipelining in the marshlands. The final report resulting from this study 2/ presents a description of gas pipelining operations and of

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1/ The Offshore Pipeline Committee is composed of ten interstate gas pipeline companies.

2/ McGinnis, J. T., et. al., 1972. Final Report on Environmental Aspects of Gas Pipeline Operations in the Louisiana Coastal Marshes to Offshore Pipeline Committee. Battelle, Columbus Laboratories, Columbus, Ohio.

the natural and socio-economic environment, and analyzes the effects of gas pipelining on the physical, biological, and socio-economic facets of the environment.

D. Other Mitigatory Measures

1. Special Stipulations

Leases for oil and gas exploration and development are subject to all OCS operating regulations and orders. Additionally, in some cases the lease may include special stipulations which are considered necessary for the protection of a particular resource, or activity, such as the one presented in Part B. above. These stipulations can be designed to meet the needs of a particular resource, e.g., wildlife or waterfowl refuges, fishing areas, certain recreation areas, protection of archeological or historical values, etc., which might be quite sensitive to development of the lease. In this proposed sale, it is believed the following suggested lease stipulations will help mitigate potential impacts on the resources identified below:

(1) It is proposed that the following stipulation be applied to any lease resulting from this proposed sale for the protection of historical, archeological, or architectural values:

> "Upon the discovery of any site, structure or object of historical, architectural, or archeological significance, the operator in charge of any activity related to OCS oil or gas exploration or development, including but not limited to, well-drilling and pipeline and platform placement, shall immediately report the finding to the Manager, New Orleans OCS Office, Bureau of Land Management and to the Area Supervisor, Geological Survey, and make every reasonable effort to preserve and protect the site, structure, or object from damage during the course of his operations."

(2) In addition, it is proposed that protection can be provided for Stetson Bank 1/ by application of the following stipulation to blocks A-502 and A-513, High Island Area, South Addition in the event they should be leased:

> "No drilling permits will be issued by the Area Supervisor, Geological Survey, until he has found that the lessee's exploratory and development plans filed under 30 CFR 250.34 are adequate to insure that exploration and production operations on the leased area will have no significant adverse effect on the biotic community of Stetson Bank. To aid him in his findings he shall request a report on these potential effects from the Manager, New Orleans OCS Office, Bureau of Land Management."

After the above mentioned report is filed and exploration and production operations are begun, the Bureau of Land Management's Environmental Assessment Team in New Orleans will make semi-annual inspections of the subject area with GS personnel, industry representatives, and interested experts from the scientific and academic community for the purpose of determining the effects of the operation on the biotic community of the area.

2. Notices to Lessees and Operators

These notices have the same effect or status as OCS Operating Orders and Regulations and are used when expeditious clarifications or corrections and additions to existing orders and regulations are necessary. By issuing Notices to Lessees and

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1/ For matters concerning the East and West Flower Gardens and Claypile Bank see section III. B. 5.

Operators, the extensive amount of time necessary to amend and re-publish orders and regulations is avoided. One example of a Notice, issued December 11, 1972, explains and details conditions of approval for waste water (oil field brines) disposal from OCS wells at offshore facilities. This Notice provides that such discharges shall meet applicable Federal Environmental Protection Agency or State standards for effluent limitations, whichever are more stringent, and provides for certain monitoring activities. The recent ban on PCB's was also implemented by such a notice.

3. Departures

A departure (waiver) from OCS orders or other rules of the GS Supervisor may be granted when such a departure is determined to be necessary for (30 CFR, 250.12(b)):

a) the proper control of a well,

b) conservation of natural resources,

c) protection of aquatic life,

d) protection of human health and safety,

e) protection of property, or

f) protection of the environment.

Waivers are technically based decisions and are granted in situations only where expert judgment determines that better, safer operations would result from operations under the waiver.

4. Research on Advanced Technology

EPA and Coast Guard are conducting research on more efficient containment and recovery devices (booms and skimmers). The efficiency of booms and skimmers depends on sea state and spill conditions but in any case are never 100% efficient. When the results of these studies, and any other similar studies so indicate, the requirement for use of better techniques and equipment will be incorporated into the OCS regulations and orders as appropriate. If incorporated, the requirements will be applied to all leases.

5. Geophysical Information

High-resolution geophysical data covering all tracts to be offered for sale will be purchased and analyzed by GS geophysical personnel. These data, in the area of coverage, provide definitive information on (1) thickness of the unconsolidated sediments; (2) structural configurations on shallow seismic horizons (300-500 feet below ocean bottom); (3) anomaly maps identifying sea floor anomalies, and mud mounds, mud waves or potential slide areas, pipeline and other objects on the sea floor, and bore hole locations as interpreted from a combined analysis of several geophysical measurements, and (4) contoured water bottom maps.

The latest interpretation of high resolution bottom profile data that will disclose bottom and subsurface conditions that might pose special

environmental hazards for drilling or producing operations is made available to the Bureau of Land Management OCS Manager prior to his decision as to whether a lease shall be issued and to the Geological Survey Area Supervisor prior to his approval of drilling operations.

The Conservation Division of the GS is aware of the nearsurface structural configuration and its effect(s) on drilling, fixed-structural emplacements, pipelines, etc., relative to the proposed lease tracts. Knowledge of nearsurface structural conditions is fundamental to a sound lease management program for the OCS.

Geophysical data, which show the shallow structural and sedimentary environment, are used to predict, and thus minimize, any geologic hazards to drilling operations and consequent possible dangers to the environment, from pollution. Surface and shallow subsurface geologic hazards, when properly identified and correlated with surrounding strata, seldom create insurmountable obstacles to a minimal risk program of exploration and exploitation of economically attractive structures.

A study of the data over the tracts recommended for the Texas sale does not disclose any obvious hazards to normal drilling operations. The sea floor, over the proposed sale tracts, is essentially flat with few topographic expressions of any kind. The most noteworthy

feature observed was a geologic unconformity extending over most of the area of interest. This unconformity is indicative of an old erosional surface covered by terrigenous deposits. (The few bottom topographic features noted probably indicate deeper structures which have been active during the period of recent deposition.) Good seismic reflections from the nearsurface layers indicate a certain degree of compaction and consolidation over most of the sale acreage; however, detailed bottom studies and core hole programs, such as those routinely performed prior to platform location, are necessary to establish the degree of compaction. Some shallow faulting was observed in many blocks; however, appropriate safety precautions 1/ should eliminate any risk to drilling operations.

6. Conservation Practices

The Oil and Gas Supervisor, in the interest of conservation, is authorized pursuant to the Code of Federal Regulations, to approve well locations and well spacing programs necessary for proper development giving consideration to such factors as the location of drilling platforms, the geological and reservoir characteristics of the field, the number of wells that can be economically drilled, the protection of correlative rights, and the minimizing of unreasonable interference with other uses of the Outer Continental Shelf. The Supervisor draws his authority from the following regulations and OCS operating orders:

1/ The District Engineer, Geological Survey will prohibit the placement of platforms on areas of instability, should the need arise, through his authority to issue or not issue permits for platform placement.

30 CFR 250.11 outlines in broad terms the Supervisor's authority to control development of the OCS, to protect the environment, and to obtain maximum economic recovery of mineral resources under sound conservation practices.

30 CFR 250.17 dealing with well spacing authorizes approval of well locations, platform locations, and lists factors for consideration in this regard. 30 CFR 250.30 requires lessee's compliance with OCS Orders as well as general regulations and demands all necessary precautions to prevent damage, waste, and injuries.

30 CFR 205.34 requires the lessee to submit to the Oil and Gas Supervisor exploratory drilling plans, lease development plans and applications for permits to drill prior to these drilling programs. The Oil and Gas Supervisor utilizes well information such as electric well logs, core information from other wells previously drilled in the vicinity of the proposed drilling program and geological and geophysical data and other pertinent reservoir information to determine the proper number of wells necessary for development.

30 CFR 250.50 grants the Director authority to demand pooling or unitization which the Secretary is authorized to require under the OCS Lands Act in the interest of conservation.

30 CFR 250.51 refers to the unit plan regulations 30 CFR 226 in regard to obtaining approval of units or cooperative agreements.

30 CFR 250.52 lists purposes for which the Supervisor may approve pooling or drilling agreements.

30 CFR 250.16 authorizes the Supervisor to specify the permissible production of a well. Thereafter, OCS Order No. 11 establishes the production rate control at the Maximum Efficient Rate (MER) of the well or reservoir. MER is defined in OCS Order No. 11, see Attachment G.

7. Other Requirements

In addition to the Interior Department's requirements, the operator must comply with applicable navigation and inspection laws and regulations administered by the U.S. Coast Guard. These relate to safety of personnel and display of prescribed navigational lights and signals for the safety of navigation. Permits to install islands and fixed structures and the drilling of wells from mobile drilling vessels must also be obtained from the U.S. Army Corps of Engineers, which is authorized by the Outer Continental Shelf Lands Act to prevent obstruction to navigation. The decision as to whether a permit will be issued by the Corps of Engineers is based on an evaluation of the impact of the proposed work on the public interest. Factors affecting the public interest according to the Corps of Engineers include, but are not limited to, navigation, fish and wildlife, water quality, economics, conservation, aesthetics, recreation, water supply, flood damage prevention, ecosystems, and, in general, the needs and welfare of the people. Pipeline construction must also be in compliance with standards established by the Office of Pipeline Safety, Department of Transportation. The Department of Labor establishes Occupational Safety and Health Standards which are applicable to OCS operations.

V. UNAVOIDABLE ADVERSE ENVIORNMENTAL EFFECTS

As described in section III. A. of this Statement, certain features of oil and gas operations cause adverse effects which are unavoidable. A capsule summary of the significant effects from this sale are identified below. In addition, although oil spills resulting from this proposed sale are not considered to be unavoidable, some of the effects of an oil spill, if one should occur, are considered unavoidable and are also discussed below.

A. Effects on Marine Organisms

Several oil and gas operations result in temporary increases in turbidity. These operations include the discharge of drilling fluids and the excavation of pipeline trenches by jetting and dredging. When turbidity is generated near the water surface, the depth of penetration of sunlight is diminished. This leads to a decrease in the output of the photosynthetic mechanism of the phytoplankton. The dimensions of the area affected are small and consist of a plume a few feet to several yards in length. The duration of the turbidity in a given location will be several hours if the source is pipeline burial operations, and several weeks to several months if the source is drilling fluid discharge. The effect of a decrease in primary production on the marine ecosystem is adverse. The area involved is very small and any reduction would only occur locally and would not involve the entire population of marine organisms.

Clogging of respiratory surfaces and filter-feeding mechanisms could reach a severe level in the benthic animals, however. The result of turbidity will be physiological stress, and possible mortality. This impact will be encountered during pipeline jetting operations and will be restricted to the down stream direction of the ocean current. The duration of the impact in a given area will be no longer than a few hours, but if it occurs in shellfish beds and similar concentration of organisms the impact could be considered adverse.

Exposure of biota to harmful or toxic materials released into the marine environment or coastal marsh such as from accidental spills of crude oil, fuel and solvents, and the routine discharge of formation waters will bring about an adverse effect where this occurs. The effects of heavy concentrations of crude oil and petroleum derivatives, depending on their composition, consists of physiological toxicity or physical smothering or a combination of both. The more subtle effects of light contamination may be serious also, but are not well understood at this time. Some specific types of this effect are:

1. Marine phytoplankton have been shown to suffer stress and mortality when exposed to oil during laboratory experiments.

2. Copepods have been found ingesting and passing oil droplets without apparent harm. The copepods, however, serve as an important link in the food chain between phytoplankton and larger animals and ingested hydrocarbons are therefore passed on to larger organisms.

3. All marine plankton present near the core of the plume of formation water, before it is sufficiently diluted by sea water, will suffer stress or mortality from concentrations in the plume.

4. Laboratory experiments show that fish may be killed during the egg and larval stage after exposure to crude oil. Respiratory surfaces became clogged and damaged in juvenile and adult stages. These effects would occur when spills come in contact with eggs and larvae in the breeding zones.

5. In the event of an oil pipeline leak in the coastal marsh, rooted vegetation would be effected according to the severity of the spill. A light spill may do little damage if any or at most may kill the emergent shoots. A severe spill however, may contaminate the substrate and kill the root systems. In the former case, new growth will usually appear the following season. In the latter, several years may be required for recovery. Small attached, crawling and burrowing animals in contact with the oil would likely be killed.

6. Although large numbers of bird deaths have not been a feature of past oil spills in the Gulf of Mexico, the possibility exists that an oil spill in the Gulf or in coastal marshes could lead to contamination and death of shorebirds, wading birds, and others. If this were to happen it would be an adverse effect. Although the potential for harm is present, the inability to predict accidental oil spills makes an assessment of the scope of the effect on birds uncertain.

Damage to immobile, attached, and rooted organisms during excavation and reworking of sediments and soil, and discharge of sedimentary materials can occur from the discharge of drill cuttings, entrenching of subsea pipelines, burial of pipelines through beach and adjacent coastal wetlands. Discharge of drill cuttings leads to a deposit of fresh, clean sand-to-pebble sized material on the sea floor in a large circular pattern. In a small area, the deposit attains sufficient thickness to smother and bury non-motile benthic animals. During emplacement of subsea pipelines, sediments and benthic animals are washed out by hydraulic jetting. Softer life forms are likely killed, others are made vulnerable to predation, and in immediately adjacent areas of down stream ocean currents, some burial and smothering could be expected. The effect is limited to local areas around drill holes and pipeline paths. In these areas, the effect is adverse and unavoidable.

B. Wetlands and Beaches

Disturbance of beach and wetlands biota during pipeline burial by trench and backfill operations, tears up all rooted plants and non-motile animals in the path of the pipeline, leaving a barren strip several feet wide. Some slight damage may also be rendered to adjacent vegetation by machinery used in the operation. The effect is localized but adverse for the smaller organisms destroyed.

C. Deterioration of Air Quality

Air quality will not be seriously impaired by routine operations, however, degradation could result from several types of accidents.

In a natural gas leak or gas well blowout degradation would be small; air pollutant would be mostly methane which quickly volatilizes and drifts away. If a fire results, pollutants would be largely carbon dioxide and water vapor.

Oil leaks and oil spills not accompanied by a fire, produce pollutants of lighter ends, i.e., more volatile components of crude oil. Their degree of degradation is unknown, but resultant photochemical smog is a possibility. If the spill results in a fire, large amounts of particulate carbon, and oxides of carbon, along with smaller but

unknown amounts of sulfur oxides, nitrogen oxides, evaporated crude oil liquids, and partially oxidized compounds, would enter the air. Local air quality would be severely degraded during the period of the fire. This effect, should a fire occur, would be considered adverse and unavoidable.

D. Deterioration of Water Quality

Degradation of water quality by routine operations will be minimal. Brines added to sea water quickly diffuse through the water column.

Moderate to severe degradation would occur however in the event of an accidental oil leak or spill. The effects of water quality degradation on the biotic community would be the major concern if this occurred. As with all accidents the uncertainty exists, but were it to occur, the effect would be adverse. In addition, water quality degradation could occur onshore if operators fail to follow state water quality standards.

E. Interference with Commercial Fishing Operations

As described in earlier sections, trawling operations suffer interference and inconvenience from oil and gas operations in several ways. A small portion, up to 0.3% of each tract leased, of sea floor is occupied by drilling rigs and platforms and is unavailable to trawl fisheremn. Based on past exploration success rates, up to 180 acres

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of sea floor may be occupied by platforms resulting from this proposed sale. Trawling nets, reportedly become entangled on underwater stubs and unburied pipelines, causing damage or loss of the nets. Less frequently, large objects lost overboard off petroleum industry boats and platforms are caught in trawling nets, damaging the net or its catch of fish. The frequency of occurrences of this nature is unknown.

Although commercial fishermen could be expected to get out of the area of an oil spill, spilled oil could coat or contaminate commercial fish species, rendering them unmarketable. This would be another adverse effect to commercial fishing.

F. Interference with Ship Navigation

Very little interference can be expected between drilling rigs and platforms and ships that are utilizing established fairways. However, at night, and especially during rough weather, fog and heavy seas, ships not navigating the fairways could collide with fixed structures. Also fishing boats engaged in trawling will be inconvenienced by having to navigate around fixed structures located on fishing grounds. Based on past exploration success rates, up to 130 new platforms could result from the proposed sale. Added to the 1,935 platforms now in the Gulf of Mexico the increment is small but is still a marginal increase in possible interference with shipping.

G. Damage to Historical and Archeological Sites, Structures, and Objects

During excavation ferrous objects above a certain size will be detected by magnetometer surveys of proposed pipeline routes. Other as yet undiscovered sites, objects, or structures not detectable by such surveys could be damaged if they are in the path of pipelines. The incidence of this occurrence is considered to be low. Were it to occur it would be considered to have an adverse effect.

Other damage to archeological resources could come from oil contamination. Historical and archeological materials soiled by an accidental oil spill may not survive subsequent cleaning and restoration efforts. Porous materials could be rendered unsuitable for carbon dating techniques. The uncertainty that such a polluting event will occur is large and the potential for significant resource destruction appears small, although it does exist.

H. Interference with Recreational Activities

Interference with recreation is closely related to degradation of aesthetic values. Oil contaminated beaches and freshly cut pipeline routes would normally be avoided by those seeking recreation sites for use or development. Disturbance of beaches by pipeline burial operations will be very short-lived, relative to recreational use. Oiled beaches may require days to weeks for adequate restoration if they become damaged. The uncertainty of accidental spills

is applicable to this event also, but if spilled oil ever reached the beach it would have an adverse effect.

I. Degradation of Aesthetic Values

Platforms and drilling rigs on six tracts included in this proposal and located between 12 and 17 miles from shore will be visible to a shoreline viewer. Up to three onshore pipeline terminals or gas treatment facilities will also be constructed as a result of this proposed sale. Where these objects to interfere with residential or recreational vistas, the visual effect, although distant, would probably be considered adverse. The incremental addition to what exists in the region is small, however. The effect, therefore, is considered small.

Spilled oil and debris floating in the water or washed up on the beach would also severely detract from the scenic values of any local area. Considerable uncertainty attaches to this possible effect. Before the natural terrain and vegetation has been completely restored, the effects of pipeline burial will appear as a large scar traversing the beach and coastal wetlands. Restoration over most of the scar will require at least one year. This latter effect is important only in the few (up to 3) vicinities where new pipelines will cross the shore area and although temporarily adverse it is generally of minor significance.

J. Conflict with Other Uses of the Land

During the laying of pipeline and the construction of pipeline terminal facilities, small amounts of land will be temporarily lost for grazing purposes. Interruption until the following growing season usually results. The existence of pipeline terminal facilities will involve the permanent loss of one to several acres for grazing, because each facility requires an access highway and is enclosed by a fence. A pipeline leak, however, involving the release of oil into grazing land would render the land contaminated and unsuitable for grazing. One to several growing seasons might be required for recovery of affected vegetation and degradation of spilled oil. The low probability of this effect and the small areas involved indicate it is minor, although were it to occur it would be considered adverse.

K. Summary

In summary, all unavoidable adverse impacts that will be sustained by the natural environment as a result of routine operations will be relatively localized in their effects. Many will be followed by unhindered natural recovery within relatively short time periods. A massive accidental oil spill could result in severe and widespread damage of major consequence. Therefore, the nine tracts identified for oil or oil and gas production in this proposed sale do contain varying degrees of potential for adverse effects of several kinds. Only the massive oil spill accident is considered to contain major potential for adverse effects of a significant nature. Here uncertainty surrounds the likelihood that one will occur. In our opinion the possibility is very low.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The principal short-term use of the proposed sale area will be the extraction of oil and gas from those tracts which prove economically productive. This mineral extraction will contribute to the diminishment of the long-term productivity of the oil and gas resources of the Gulf of Mexico and possibly to marine and coastal resources.

To date, a decrease in marine productivity has not been detected in OCS areas where oil and gas have been produced for many years. Concern has been expressed regarding the possibility of long-term reduction in productivity of the overall ecosystem resulting from continued oil and toxic chemicals being spilled into the water. The possibility that the implementation of this proposed lease sale together with existing production on the Outer Continental Shelf might sacrifice the long-term productivity of the area to the short-term use of mineral resources might be recognized even though the long-term effects of oil spillage into the environment are not clearly understood at this time.

The additional stress which the ecosystem can absorb is limited, but at present, the bounds of these limitations are not known. St. Amant

observes, "Certainly the significance of the continual addition to and accumulative effects of sublethal pollutants in the environment is probably the most important ecological question facing us today." 1/

It is not anticipated that other impacts caused by oil and gas operations will decrease either short-term or long-term productivity in the ocean.

Disturbance of the marsh by pipeline construction and burial operations will decrease productivity in the short-term only. In the absence of grazing, productivity of the marsh in the area disturbed by pipeline operations will increase following the disturbance and will fall off to natural levels as original conditions are restored in subsequent growing seasons. Light grazing pressure most likely will not have any effect, but heavy grazing could serve to keep the disturbed area from recovering at an optimum rate. Species diversity in the disturbed area will be low during the recovery period.

Based on past leasing and exploration experience, as many as 130 new platforms will be emplaced as a result of this proposal.

1/ St. Amant, Lyle S., "Biological Effects of Petroleum Exploration and Production in Coastal Louisiana", Louisiana Wildlife and Fisheries Commission, December 1970. p. 20.

The cumulative affect of structures on multiple-uses in offshore areas where more and more structures are required as OCS production increases is one of concern. The cumulative nature of structures as hazards to commercial shipping and as obstructions to commercial fishing activities represents a use conflict that can be controlled through proper planning and coordination with appropriate Federal and state agencies and private industry. Some levelling out in numbers of platforms is expected as more and more areas go out of production and platforms are removed. This same feature is also expected with regard to the cumulative numbers and length in miles of pipelines to shore. In the case of pipelines, as more and more areas begin to approach termination of production, some additional capacity will be available in existing pipelines to carry production from new areas thereby reducing the numbers of new pipelines required to move production to shore. We are unable to determine at this time if the total number of platforms and pipelines required to develop the OCS areas in the Gulf of Mexico has peaked but indications are that conditions are approaching a levelling off point.

From the information at hand, long-term productivity of the Texas Gulf environment, we believe, is not being reduced.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A. Mineral Resources

The leasing of the proposed tracts in this sale would permit development and extraction of the leasable minerals. This lease sale could result in an estimated range of production of 30-60 mm bbl. of oil and 5.4-7.6 tcf of gas which would represent an irreversible and irretrievable commitment of mineral resources.

B. Land Resources

It has been estimated that three new pipelines to shore will result from this proposed sale. In connection with these pipelines, up to three new onshore pipeline terminal stations or gas treatment facilities will be constructed. This construction would involve the irretrievable commitment of several acres of coastal marsh for driveways and station or facility sites.

C. Fish and Wildlife Resources

An irreversible or irretrievable commitment of fish and wildlife resources and their habitats could occur in the area of a massive oil spill or if frequently subjected to chronic low levels of oil pollution. At this time, there is insufficient evidence to conclude that low level spillage has led to an irreversible commitment of fish and wildlife resources but there is enough evidence to indicate that this is a possibility that deserves close attention, and constant study.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

A. Hold the Sale in Modified Form

The proposed sale could be held by offering only those tracts determined to have a low potential for environmental harm. Because no tracts in this proposed sale are considered to have high environmental damage potential this alternative would require the elimination of all tracts considered moderately hazardous to the environment. The environmental impact of this possible modification would be essentially the same as that discussed below concerning the offering of gas tracts only because the gas tracts all have a relatively low potential for environmental harm and the oil or oil and gas tracts all have a moderate potential for environmental harm. This modification could also allow for special stipulations (including and in addition to those presented in section IV.) on any proposed tracts where additional requirements might be necessary to protect the environment or to minimize or eliminate possible conflicts with, or potential damage to, other resource values or commercial uses of the Gulf of Mexico and the adjacent land areas.

To modify the proposed sale by offering only those tracts estimated to be gas producing would avoid some of the potential adverse environmental effects related to this proposed sale. It would eliminate or significantly reduce the potential hazard to the environment from possible oil pollution events that could result from this sale as proposed.

With this modification, the proposed sale could go forward with very little, if any, adverse impacts expected as a result of oil pollution on the marine and coastal environments, the resources, and related activities of the area offshore Eastern Texas. This modification would require elimination of all proposed tracts in the Galveston Area, 9 in all. Elimination of these tracts would result in the loss to this sale of the 30-60 million bbl. of the estimated recoverable reserves for oil which would have to be made up from some other source.

However, development of gas prone tracts only would still require seismic exploration, exploratory drilling, construction of permanent platforms and pipelines, production well drilling, workovers, maintenance and repair work with the attendant potential adverse environmental impacts discussed in detail throughout this environmental statement for those activities. If this alternative is followed, the overall importance associated with these activities with regard to the environment would be essentially the same as it would be if all the proposed tracts were offered. However, the magnitude of potential impacts would be reduced and the cumulative impacts associated with quantities of waste water effluents and debris, and the numbers of platforms and pipelines required to develop gas prone tracts only would be lessened. With this alternative the environmental effects of pipelines, as previously discussed, would apply, but instead of a

maximum of three pipelines needed to develop the tracts as originally proposed, possibly only two would be required. The same principle for platforms would apply, that is, the environmental effects associated with offshore platforms would be the same as those previously discussed, but with the removal of the 9 tracts from this proposed sale expected to be oil or oil and gas prone, the total number of platforms resulting from the sale if this alternative is adopted would be less than originally proposed. In any case, the potential environmental impacts as discussed in section III. of this statement also apply to this alternative with the exception of impacts resulting from oil pollution events and with a diminution in overall cumulative impacts.

B. Withdraw the Sale

In addition to modification of the proposed sale, all tracts could be withdrawn from leasing consideration. A decision to withdraw the sale completely or to seriously limit the number of tracts to be leased would diminish the contribution of OCS gas and oil toward meeting future energy demand, and would subsequently necessitate development of alternative sources of energy, with their associated environmental impacts. It should be emphasized that the sale is expected to yield primarily natural gas, a relatively clean-burning, environmentally superior fuel. Therefore, not holding the sale might precipate the turning to less environmentally acceptable sources of energy. This point was emphasized by the American Gas Association at the hearing on the proposed sale. 1/ The environmental impacts associated with not holding the sale can be found in the assessment of possible short-term alternatives on the following pages.

1/ Statement by Robert R. Herring, President and Chief Executive Officer, Houston Natural Gas Corporation on Behalf of the American Gas Association, presented at the 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale Hearings, February 21-22, 1973, Houston, Texas.

The production from tracts projected for leasing at this sale would also represent a significant contribution toward meeting domestic energy needs. The sale is expected to contribute to the supply of relatively short-run energy requirements (i.e., 5 to 15 years). Few alternatives exist to help offset the need for domestic oil and gas during this period. The alternatives discussed below are those which may help meet projected energy demands in the event the proposed sale is withdrawn.

The following represents a list of energy sources or actions which, if implemented, might be considered as alternatives to offshore oil and gas in supplying short-run energy needs:

1. Increased oil imports
2. Increased onshore oil and gas production
3. Increased nuclear power
4. Increased use of coal
5. Increased hydroelectric power
6. Modification of FPC natural gas pricing
7. Oil shale production
8. Stimulation of recovery from known deposits
9. LNG imports
10. Synthetic natural gas
11. Energy conservation
12. Combination of alternatives

The general approach used in analyzing each alternative has been to initially review the energy potential of each source in terms of British thermal units (btu's). Restrictions

involved in using the available energy as a substitute are then discussed. The sale under consideration primarily involves gas reserves, and it has been necessary to review each alternative from the perspective of ability to substitute directly for the gas or possibly to meet energy requirements now being met by gaseous fuels thereby freeing gas supplies. Some of the problems to industries in substitution of another fuel for natural gas were enumerated in comments received from United Distribution Companies on the draft statement for the proposed sale. They are as follows:

(a) Conversion to a liquid fuel involves construction of facilities for storing an inventory of oil as well as related piping, pumps and heaters, even where liquid fuel can do the job.

(b) The capacity of production equipment is sometimes reduced when fired by a fuel other than gas, e.g., the melt in a glass furnace must be reduced when a fuel more luminous than natural gas is burned, and similar difficulties may result if ammonia plants switch from methane to heavier feed stocks. This may result in up to 25% lost capacity in such plants.

(c) Breakage or spoilage increases in certain industrial processes where less desirable fuels are substituted for natural gas. This problem occurs in refractory manufacture or metallurgical processes.

(d) Maintenance costs increase in certain industrial applications when gas is replaced by even a high grade liquid fuel. This is true, as one example, in the operation of turbines.

(e) Natural gas is used as process fuel in many plants and its replacement would be most difficult from a technological point of view. For example, in ammonia reforming furnaces temperature distributions within the furnace are critical so that the different flame characteristics produced by oil create operating problems. Also, the sulphur and ash content of the fuel must be very low in order to minimize tube corrosion in the presence of extremely high temperatures. It has been estimated that for a plant with a rated capacity of 1,000 tons of ammonia per stream day, or 340,000 tons per year, additional investment outlays of approximately $450,000 would be required to convert from natural gas to a liquid fuel.

(f) Natural gas has special qualities in the metallurgical industry where exact temperature controls, low flame emissitivity, convective heat transfer and minimization of hot spots are important. Heat treating and annealing furnaces cannot easily be converted from natural gas to other fuels.

(g) In most cases, equipment will need to be modified and, in some cases totally replaced, in order to accommodate a different fuel. Complete replacement of direct flame makeup air heaters for a paint drying line in the automotive industry could entail a new investment equal to 150% or more of the price of the replaced gas burning heaters.

(h) Natural gas provides approximately half of the petrochemical industry's supply of feed stocks and economic dislocations can be expected if it is no longer available.

(i) In the manufacture of cement, natural gas has technical advantages not only because gas firing rates are easier to control, but also because cement must not contain excessive amounts of sulphur and sulphur is already present in the raw material before it enters the kilns.

The discussion of each alternative includes a general description of the alternative, an indication of the amount of the alternative required to meet projected energy demands that would not be met should the proposed sale be withdrawn, a statement on the technological feasibility of the alternative's being used as a substitute, a consideration of the environmental impact of the alternative, and a description of the impact, if any, on the health and safety of individuals directly or indirectly involved with the alternative.

Supporting analyses for developing the tentative five-year leasing schedule, the linear transportation model for natural gas and a similar study to be initiated for oil, are useful in determining the extent to which some of the energy alternatives can be regarded as actual substitutes for the estimated oil and gas production from the subject sale. The linear transportation model for natural gas allocates projected supplies of natural gas to consumer demand

regions on the basis of least cost and identifies national and regional supply gaps. It gives an indication of what regions OCS natual gas production serves and where the large deficits will exist. The analysis for oil will identify future imbalances in that product's market by comparing projections of future supplies and demand forecasts on a regional basis. In some instances, the distance of an alternative source of energy from the projected consuming region which would be served by the expected Texas OCS production precludes that alternative as an actual substitute for the OCS production. This is discussed under the specific alternatives.

Other limitations on substitutability include technology, high development and production costs, and time lag before the alternative could be a viable technical option. In early stages of development of an alternative source of energy, it may serve more as a supplement than as a substitute. Furthermore, there are some cases in which substitutability is diminished because of the projected use of the offshore oil and gas. These limitations are noted in the individual alternative discussions when applicable.

The discussion of these alternatives as presented below includes a consideration of the possibility of energy conservation as a method which might decrease or eliminate some of the energy requirements to be satisfied by this sale. A table has also been prepared showing the incremental production potential of the alternatives considered and the possibility of having a combination of sources substitute for the proposed sale.

There are additional potential energy sources which hold great promise for the future. They are not, however, sources which are considered to be reasonably available to meet short-run energy demand, since their utilization will depend on future technologic development, economics, and adequate environmental safeguards.

The development of energy sources such as desulphurization of coal, tar sands, geothermal resources and solar energy are in this category, but the impact of these sources on the energy supply will not be significant until after 1980. These energy sources are considered to be supplements rather than

the alternatives to offshore oil and gas development in the short-run. Therefore, energy sources in this category will not receive examination, at this time, as possible alternatives to this proposed OCS oil and gas lease sale. 1/

1/ These alternatives have received detailed consideration by the Department as part of the Environmental Impact Statement and the administrative review for the Trans-Alaska Pipeline, and are available for examination by all interested parties.

1. Increased Oil Imports

Prior to the final preparation of this section, the working group of the Oil Policy Committee was consulted and suggestions were made on how to improve the analysis. This section has been revised as a result of these comments.

a. Description of the alternative

Based upon the Department of the Interior's most recent forecast, "U. S. Energy Through the Year 2000", estimated 1980 oil supply will most likely be 20.8 million barrels per day (44 Percent of demand). Corresponding projections for 1985 indicate a demand of 25.0 million barrels per day with a domestic production deficit of 13.3 million barrels per day (53 percent of demand). Such deficits must be provided for either by (1) conservation of energy, (2) increased oil imports, or (3) development of additional sources of domestic supply, or (4) a combination of 1, 2 and 3.

Assuming the continued availability of foreign oil supplies at attractive prices, two Federal actions could open the way for increased oil imports. First, oil imports quotas can be increased in almost any quantity and manner within the context of the existing Mandatory Oil Import Program including removal of controls. Second, all oil import quotas could be replaced by

a tariff system designed to limit oil imports and third, some combination of the two actions could be instituted. The extent of oil imports under restrictive tariffs would be primarily a function of rates imposed, the relationship between foreign and domestic oil prices, and transportation costs. A major issue is the extent to which oil import controls are needed to maintain domestic production capabilities required to meet national security needs.

Assuming that there would be no substantive change in U. S. energy policy, analysis indicates that oil imports will need to increase rapidly. First indications of this increase were apparent in 1972.

(1) Mandatory Oil Import Program

Imports of crude oil, unfinished oil, and oil products are controlled under the Mandatory Oil Import Program established in 1959 by Presidential Proclamation 3279. The statutory foundation for Presidential action started with Section 2 of the Trade Agreements Extension Act of 1954 which prohibited any decrease in duty on any article if such reduction would threaten domestic production needed for national defense. Section 7 of the Trade Agreements Extension Act of 1955 added a subsection (b) which authorized the President to restrict imports found to be threatening to impair the national security. It

established a two-step procedure: an opinion by the Director of the Office of Defense Mobilization 1/ of as to whether imports of a particular article are threatening to impair the national security, followed by a determination by the President of both the relevant facts and of the action he deems necessary to counteract the threat. The statute was further amended by Section 8 of the 1958 Extension Act in several important respects: (1) to require the President to take remedial action upon a report by the Director of OEP (now from the Deputy Secretary of the Treasury), "unless the President determines that the article is not being imported" in a manner threatening the national security, (2) to authorize the President "to take such action, and for such time, as he deems necessary" to adjust imports for the purpose, and (3) to set forth in a new subsection certain standards to be considered; chiefly the impact of imports on "domestic production needed for projected national defense requirements" and on the "capacity of the U. S. to meet national security requirements,: as well as the "impact of foreign competition on the economic welfare of individual

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1/ By Executive Order No. 11703, supervision over the oil import and surveillance program was transferred from the Director, Office of Emergency Preparedness, to the Deputy Secretary of the Treasury who is now chairman of the Oil Policy Committee.

domestic industries" so as to determine "whether such weakening of our internal economy may (itself) impair the national security." As so amended, the statutory provisions were incorporated without substantive change into the Trade Expansion Act of 1962 as Section 232.

As stated in Presidential Proclamation 3279, the purpose of the Oil Import Program is to protect the national security by restricting imports from foreign sources, thus insuring a stable, healthy industry in the United States capable of exploring for and developing new hemisphere reserves to replace those being depleted.

The limiting of imports of oil into the United States basically is a problem of balancing a sufficient level of imports with domestic production without depressing or eliminating domestic crude oil exploration, development, and production efforts.

(2) Present Operation of the Oil Import Program

Administrative Responsibility

On February 20, 1970, the President established the present Oil Policy Committee and directed at that time that: "While most day-to-day administrative functions will continue to be performed by the Oil Import Administration (now Office of Oil and Gas) of the Department of the Interior, the policy, direction,

coordination, and surveillance of the program will be provided by the Director of the Office of Emergency Preparedness (now scheduled to be abolished July 1, 1973), acting with the advice of this permanent Oil Policy Committee".

On January 26, 1973 and in response to the increasing possibility of energy shortages, the President announced a reorganization of his executive office. The Office of Emergency Preparedness will be abolished July 1, 1973, and its oil policy role will shift to the Treasury Department. The Oil Policy Committee will then function under the general supervision of the Deputy Secretary of the Treasury. The Treasury will assume the responsibility for investigations of imports which might impair national security, which is the basis for controls on oil imports, under Sec. 232 of the Trade Expansion Act, and will be the lead agency in shaping the method by which imports are restricted or make key findings leading to elimination of all restrictions. The President, on advice of the Chairman of the Oil Policy Committee can abolish the program at any time he finds there is no longer a threat to security. The price-surveillance role which OEP held has also gone to the Treasury.

Prior to this reorganization, the OPC was made up of representatives from OEP, Treasury, Interior, Commerce, Defense, Justice, State, and the Council of Economic Advisers, in addition there were observers from the EPA, the OMB, and the White House. In abolishing OEP, the President cited the need for streamlining and to shift responsibility from his immediate staff to the departments and agencies.

Allocation Guidelines

Presidential Proclamation 3279, as amended, restricts petroleum imports into the United States by product (commodity), geographical area in the United States and, in some instances, country of origin.

Allocations of imports of crude oil, unfinished oils, or finished products are made for a period of 1 year--that is, January 1 through December 31, except that allocations of imports into Petroleum Administration for Defense (PAD) District I of residual fuel oil to be used as fuel and allocations of crude and unfinished oils in Puerto Rico are made on an annual basis beginning April 1.

Prior to the beginning of each allocation period, the Director of the Office of Oil and Gas determines the quantities of imports of crude oil, unfinished oil, and finished products which are available for allocation in Districts I through IV, District V, and in Puerto Rico respectively. He also determines the quantities of imports of residual fuel oil to be used as fuel in Districts I and V.

Applications for allocations of imports of crude oil, unfinished oils, or finished products and for a license or licenses must be filed with the Director, Office of Oil and Gas not later than 60 calendar days prior to the beginning of the allocation period for which the allocation is required. Allocations of crude oil and unfinished oil are made to petrochemical firms and to oil refineries. Refinery allocations are made relative to the refinery inputs of the prior 12-month period ending September 30. A sliding scale is used to give preference to small refiners.

Allocations and levels for the importation of petroleum are published annually for Petroleum Administration Districts I-IV (States East of the Rocky Mountains), District V (West Coast States, plus Alaska and Hawaii) and Puerto Rico. For purposes of import controls, petroleum imports are generally categorized as crude, unfinished oils, finished products, No. 2 fuel oil, asphalt, and residual fuel oil.

Product imports are almost negligible, except for the fact that import controls on No. 2 fuel oil into Districts I-IV were suspended for the first four months of 1973; currently the program calls for the reinstitution of controlled No. 2 imports. Other exceptions are unrestricted but licensed quantities of residual fuel from overseas sources into District I (the East Coast States plus Vermont and West Virginia), asphalt into

Districts I-IV, and finished products manufactured from Canadian crude and imported over-land from Canada into Districts I-IV. Imports of other products such as gasoline have been intentionally discouraged to minimize the "exportation" of refining capacity.

Special arrangements are made for imports into Puerto Rico, and for shipments of relatively small quantities of products from Puerto Rico (102,000 barrels per day, 38,000 of which is outside the quota) and imports from the Virgin Islands (15,000 barrels per day) to the mainland.

Imported unfinished oils (15 percent of the license in District I-IV and 25 percent in District V), as well as crude imports are further processed upon entry into the U. S. These oils are imported primarily by refiners, although some licenses are granted to petrochemical producers.

Allocations to refiners are made according to a sliding scale based on refinery inputs. Petrochemical allocations are computed as a percentage of inputs (11.2 percent in Districts I-IV and 11.9 percent in District V).

The level for imports into District V is computed as the amount required to supplement shipments from other PAD Districts,

estimated domestic crude production, and overland imports from Canada so as to meet estimated demand in District V. The level for imports into Districts I-IV was calculated as a percentage of estimated domestic consumption during the early years of the Mandatory Oil Import Program. Residual fuel and certain other products such as Canadian Natural Gas Liquids and Western Hemisphere Liquid Petroleum Gas enter without restrictions. There is no import quota system on importing natural gas although imports must be approved by the FPC.

Below are listed tentative allocations of imports in districts I-IV

(thousands of barrels per day)

Crude and Unfinished Oils	1972	1973
Canada	582.4	675.0
Mexico	23.8	32.5
Refiners, O/S	883.6	1500.0
Petrochemical O/S (11.2)	93.8	112.0
Starters	12.1	31.5
OIAB and Contingency	40.0	250.0
TOTAL	1,636.0	2601.0

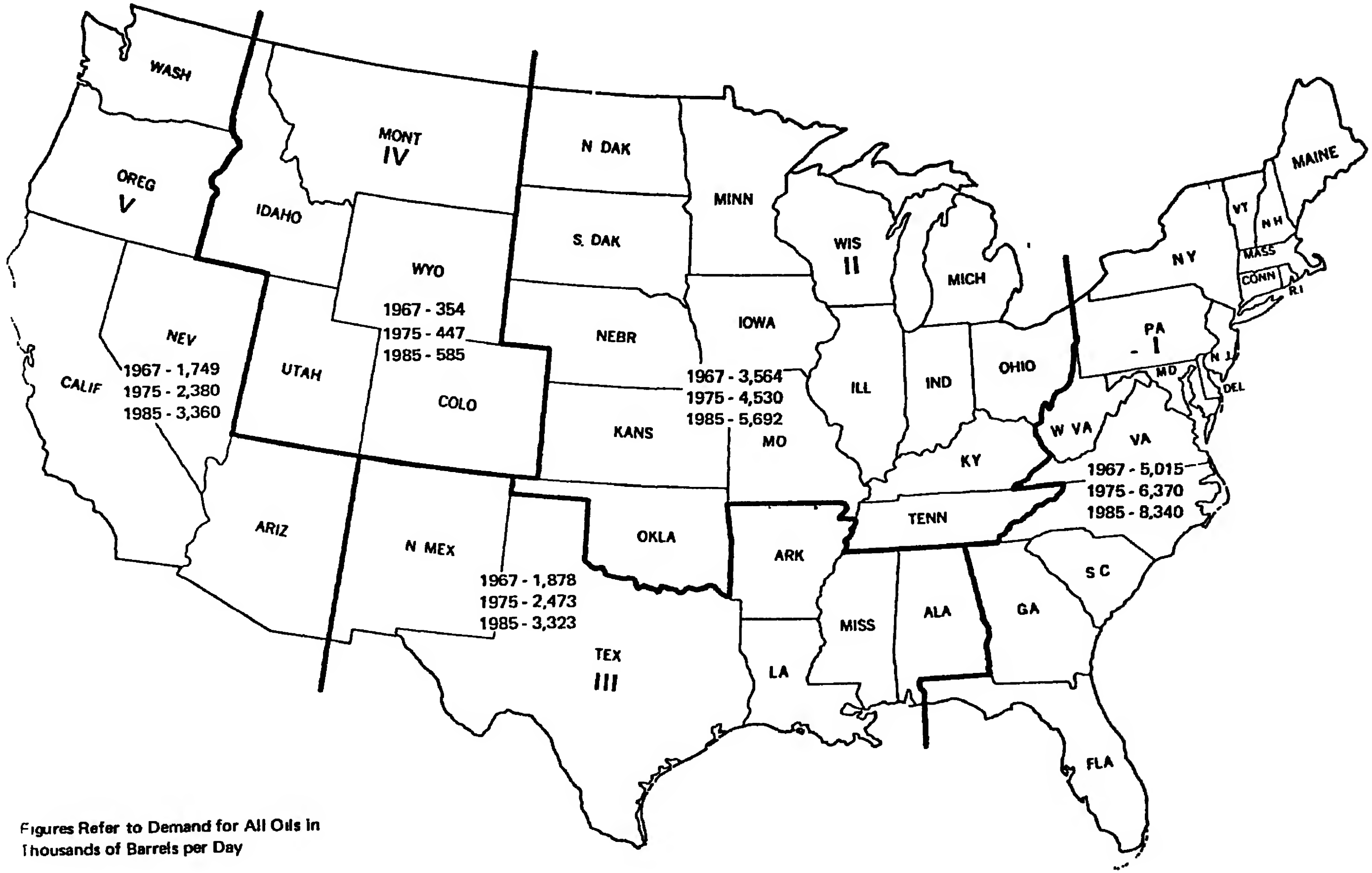
Finished Products		
Puerto Rico	64.0	64.0
Virgin Islands	15.0	15.0
Number 2 Oil	50.0	34.0
DOD	20.0	20.0
TOTAL	149.0	133.0

Allocations - District V

Crude and Unfinished Oils		
Canada	265.0	280.0
Residual Bonus Program	150.0	175.0
Refiners	278.5	465.5
Petrochemical (11.9%)	3.0	4.0
OIAB	5.0	10.0
U.S. Oil and Refining (OIAB)	8.0	8.0
TOTAL	709.5	942.5

Finished Products		
DOD	7.5	7.5
TOTAL	717.0	950.0

PETROLEUM DEMAND
IN
PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS



From: The Role of Petroleum and Gas from the OCS in the National Supply, BLM Technical Bulletin 5, May 1970.

(3) International Uncertainties

In considering the modification or elimination of the Mandatory Oil Import Program as a means of obtaining more oil to meet future demand, a particular concern is the security of Middle East supply sources which have been characterized by instability and international tension. The supplies of oil from that area may be subject to interruption for political or economic reasons with little or no advance warning. In their comments relative to the Department of the Interior's analysis of the Economic and Security Aspects of the Trans-Alaska Pipeline, the Secretaries of State and Defense and the Director of the Office of Emergency Preparedness indicated their concern that "failure to obtain desired additional oil supplies (from the North Slope) will necessitate increasing imports from insecure sources to such high levels that a long-term foreign supply disruption could slow down industry and imperil our national security".

A systematic treatment of the oil import subject is contained in the report of the Cabinet Task Force on Oil Import Control (The Oil Import Question, 1970). While the task force dasagreed over preferences for tariffs over the precent quota system as the basic method of restricting imports, there was concurrence that imports from the Eastern Hemisphere should be limited. Such a limitation would require some type of continuing import controls.

In the wake of continuing currency problems, large amounts of dollars in foreign lands, particularly the Arab countries, have added new dimensions to the oil import problem. Balance of payment deficits and currency speculation with its negative effect on the dollar have been major contributing factors to monetary instability in early 1973 with Arab oil producing states official bank holdings up to about $12 billion. These reserves are expected to double in the next three years and could be used as a monetary clout for political ends.

The Oil Import Question identified eight major difficulties that might attend dependence on foreign supplies:

(1) War might possibly increase our petroleum requirements beyond the ability or willingness of foreign sources to supply us.

(2) In a prolonged conventional war, the enemy might sink the tankers needed to import oil or to carry it to market from domestic production sources such as Alaska.

(3) Local or regional revolution, hostilities, or guerilla activities might physically interrupt foreign production or transportation.

(4) Exporting countries might be taken over by radical governments unwilling to do business with us or our allies.

(5) Communist countries might induce exporting countries to deny their oil to the West.

(6) A group of exporting countries might act in concert to deny their oil to us, as occurred briefly in the wake of the 1967 Arab-Israeli War.

(7) Exporting countries might take over the assets of American or European companies.

(8) Exporting countries might form an effective cartel raising oil prices substantially.

A subsequent study made by the Petroleum Industry Research Foundation reexamined the principal assumptions and conclusions of the Task Force regarding U. S. dependence on oil imports in 1980 under various price assumptions (Oil Imports and the National Interest, 1971).

This study raised questions relative to an indicated overstatement of both U. S. production and Western Hemisphere imports and an understatement of demand for imports from the Eastern Hemisphere which in turn raised further questions as to the extent to which the United States should depend on Middle Eastern and Eastern Hemisphere petroleum sources.

The crux of the argument against importing a substantial fraction of the Nation's oil is that the sources of additional foreign oil--in general, the Middle East, and North Africa--are "insecure", and might withhold oil exports to the United States for political and/or economic gain.

A study of Drs. Schurr and Homan for Resources for the Future 1/ notes that the question of supply interruptions:

> ". . . needs to be dealt with in the interests of both the importing and exporting countries because supply interruptions are economically damaging to both. Not only do they have sharp short-run effects which are economically painful, but their longer-run consequences can also be damaging if channels of commerce are diverted into alternatives

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1/ Sam H. Schurr and Paul T. Homan, et. al., Middle Eastern Oil and the Western World: Prospects and Problems. New York, American Elsevier, 1971.

which impose a permanent economic penalty upon both those countries that sell oil and those that buy."

However, this interdependence does not guarantee that interruption will not occur. The study points to interruptions from the shutdown of Iranian production beginning in 1951, the closure of the Suez Canal and attendant lengthening of transportation routes in 1956-1957 and again from 1967 to the present, and quotes Walter Levy, a leading international oil authority and consultant, as saying:

> "Nor can the West rely on the importance of uninterrupted oil operations and oil revenues to Middle East governments as a deterrent to hostile actions. Economic considerations, important as they are to the relatively impoverished countries of the area, become insignificant when confronted with political necessities or political pretensions."

Eleven major oil producing countries have joined the Organization of Petroleum Exporting Countries (OPEC), in an attempt to obtain greater bargaining power in their dealings with the international oil companies.

A five-year agreement between oil companies and Persian Gulf countries reached in 1971 provides for substantial increases in

the payments to the host governments. The other members followed with equal or larger increases. In the second year of the agreement, the OPEC countries have been given further increases to compensate for the devaluation of the dollar, and are demanding participation as part owners in the oil companies exploiting their resources. If OPEC can maintain cohesiveness in the face of diverse national demands and historical relationships, continuing pressure for economic and political concessions by the oil-importing countries may be anticipated.

Projections of the sources of future U. S. oil imports generally assume that Canadian and other Western Hemisphere oil will be imported to the extent to which it is available and that remaining import needs will of necessity be met from the Eastern Hemisphere.

Projections of potential contributions from Canada and other Western Hemisphere nations are shown in the following table. Additional imports from Canada will require substantial additional discoveries and further development of the tar sands industry in that country. However, tar sands do not appear to be price competitive at present. Canada exports about half its production, which is located primarily in the West, to the United States, but imports slightly more than

the amount to the Canadian East Coast. Canada's ability and willingness to maintain and increase its exports depends on its ability to satisfy domestic demands, to increase production, and to find sufficiently stable and attractive markets.

Projections of Imports From Canada and Other
Western Hemisphere Sources
(million barrels per day)

Import Source	Data Source	1965	1970	1975	1980	1985
Canada	Schurr 1/	0.41	----	0.78	0.95	----
	N.P.C. 2/	----	----	----	----	1.90
	Draft EIS 3/	----	0.70	1.10	1.60	2.20
	Bu. Mines 7/	----	0.76	----	----	1.64
	Syncrude 8/	----	----	----	1.63	----
Other West. Hem.	Schurr	1.66	----	2.46	2.82	----
	N.P.C.	----	----	----	----	1.80 4/
	Draft EIS	----	2.20	2.90	3.25	3.50
Total West. Hem.	Schurr	2.07	----	3.24	3.77	----
	N.P.C.	----	----	----	----	3.70
	Draft EIS	----	2.90	4.00	4.85	5.70
Minimum Estimate	Canada	----	----	----	0.95	1.64
	Other W.H.	----	----	----	2.00 5/	1.80
	Total 6/	----	----	----	2.95	3.44
Maximum Estimate	Canada	----	----	----	1.63	2.20
	Other W.H.	----	----	----	3.25	3.50
	Total	----	----	----	4.85	5.70

1/ Schurr, Sam H., Paul T. Homan, et. al., Middle Eastern Oil and the Western World: Prospects and Problems, New York, American Elsevier 1971, p. 28 Schurr gives imports in four categories; Middle East, North Africa, Caribbean, and "Other"; the assumption that "other" represents Canada appears consistent with other projections.

2/ National Petroleum Council, "U. S. Energy Outlook: An Initial Appraisal, 1971-1985", Vol. 1, July 15, 1971, pp. 26, 28.

3/ Draft Environmental Impact Statement for the Trans-Alaska Pipeline, prepared by Department of the Interior, January 1971, p. 185.

4/ Assuming all Latin American excess capacity reaches the United States: see National Petroleum Council, p. 28.

5/ Assumed for present purposes, based on the NPC argument that total for 1985 would be 1.80 million bb/day.

6/ Obtained by adding mini. (max.) values for Canada and other West. He

7/ Appendix 1, part 3, Vol. II of USDI, "An Analysis of the Economic and Security . . ."

8/ Syncrude Submission, exhibit 2, to Proceedings concerning Application No. 5899 to Albert Energy Resources Conservation Board, September 1971.

The contributions of other western hemisphere nations will be determined by their attitude toward their oil industries (which, though largely owned by the international oil companies, are subject to local government regulations and, occasionally, expropriation), by patterns of domestic demand, export markets in other areas, financial status, and development preferences, so that the projections of export potentials to the U. S. are conjectural.

Although the projections show substantial increases in imports from South America and the Caribbean ("Other Western Hemisphere"), other sources cite declining reserve-to-production ratios in Venezuela and the 6.4 percent annual growth in Latin American demand as evidence that demand in South America will more than absorb any increases in production. 1/ Recent discoveries in Ecuador, though still in the preliminary stage, may yield at least one million barrels per day by the late 1970's. 2/

The following table compared the projected U. S. oil imports from the Western Hemisphere (previous chart) with the overall U. S. crude oil deficits 3/ to derive probable levels of imports that would be provided from the Eastern Hemisphere. It should be noted that if all controls on imports were abandoned, the U. S. deficit would be much higher.

1/ Alberta Energy Resources Conservation Board, Proceedings Concerning Application No. 5849, September 1971.

2/ Oil and Gas Journal, February 8, 1971, pp. 24-26.

3/ USDI, "U. S. Energy Through 2000", December 1972, p. 43.

Projected U. S. Oil Imports
1980 and 1985

Year	Total Demand (mil. bbls/day)	Domestic Deficit Estimate (mil. bbls/day)	Domestic Deficit Estimate (% of demand)		Projected Imports From Western Hemisphere (mil. bbls/day)	Projected Imports From Western Hemisphere (% of demand)	Projected Dependence Upon Eastern Hemisphere (mil. bbls/day)	Projected Dependence Upon Eastern Hemisphere (% of demand)
1980	20.8	9.1	43.7%	Low	2.95	14.2%	6.15	29.5%
				High	4.85	23.3%	4.25	20.4%
1985	25.0	13.3	43.2%	Low	3.44	13.8%	9.86	39.4%
				High	5.70	22.8%	7.60	30.4%

It has been argued that the national security objectives of the oil import program could be met in other ways. Generally, these alternatives are means of coping with an interruption of supplies. They include drawing down oil stocks (which depend on storage capacity); expanding production from remaining sources (with varying incremental volume, cost, and time lag); and reducing demand by rationing (of varying formality and intensity). Such measures are alternatives to the oil import program. Due to recovery problems, large scale storage of imported crude in rock formations as an alternative to oil imports would be cost prohibitive at this time. 1/

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1/ McKetta, John C., University of Texas, Austin, Texas, 1973. Testimony at February 21-22, 1973, Texas Sale hearings.

b. Environmental Impact

Assuming imported oils are of comparable quality to domestic oils the only direct environmental hazard would be related to handling additional ship traffic and problems in onloading and offloading oil products from these ships. Indirectly, increased oil imports would reduce the environmental hazards associated with that amount of domestic production needed to replace the amount of oil imported. In addition, since the import oil quota system does not apply to natural gas and the United States does not presently have superport facilities to handle large amounts of liquefied natural gas, imported oil would have to substitute for natural gas on a Btu basis, most likely in power plant or space heating facilities where substitution is feasible. The oil, often containing significant sulfur levels, would contribute more pollution to the atmosphere than cleaner burning gas. In considering the direct environmental hazards, increased ship traffic, terminal and refinery requirements, and pollution potential at the unloading sites are all important factors.

(1) Increase in Ship Traffic

Three factors are considered in analyzing possible oil pollution as a result of increased imports: (a) intentional discharge, (b) accidental discharge, and (c) casualty analysis.

(a) Intentional Discharge

The two primary sources of intentionally discharged oil are shoreside ballast treatment facilities and underway tank cleaning operations. 1/ It may be assumed that all intentionally discharged oil in U. S.waters from this alternative will come from tank cleaning operations, and any development of ballast treatment facilities would be accomplished at the loading end of the system.

The impact of tank cleaning operations would be felt in three separate analytical areas; one assuming uncontrolled operations, one assuming load-on-top (LOT) operations, and one assuming compliance with IMCO standards proposed in the 1969 amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954.

(b) Accidental Discharge

The 1970 Pollution Incident Reporting Systems (PIRS) data indicate that approximately 0.00015% of the oil handled in the U. S. was spilled during transfer operations. 2/ In the

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1/ USDI, Trans-Alaska Pipeline System, Environmental Impact Statement op. cit.

2/ U. S. Coast Guard, "Marine Transport Systems of the Trans-Alaska Pipeline System", 1972.

restricted waters surrounding harbors and ports the 1970 experience indicates that about 0.00009 percent of the oil handled is accidentally discharged. 1/

(c) Casualty Analysis

The worldwide tanker casualty analysis indicates that an insignificant amount of the total volume of oil transported is spilled, exclusive of transfer operations. 2/ The environmental impact could be nominal where small spills are involved or where the spill occurs in such a manner as to have little impact on coastal or restricted water areas. By contrast, a single catastrophic incident such as the breakup of the Torrey Canyon can have disastrous results. The oil spill problem is a subject involving considerable study effort. The first report of the President's Panel on Oil Spills 3/ presents considerable details relative to the subject.

(2) Terminal and Refinery Requirements

The importation of increasing amounts of crude oil is dependent upon adequate port facilities and refinery capacity.

A contract study prepared for the Maritime Administration, U. S. Department of Commerce reports that the use of Very Large Crude

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1/ Ibid.

2/ USDI, Trans-Alaska Pipeline System, op. cit.

3/ U. S. Coast Guard, "Marine Transport Systems of the Trans-Alaska Pipeline System", 1972.

Carriers is necessary for importing oil because of the great distance involved (distance between Persian Gulf and Eastern U. S. is 12,000 miles). A comparison of shipping costs per ton of oil by size of carrier is as follows: 1/

Size of Ship	Shipping Cost/Ton
65,000 DWT	$9.63
250,000 DWT	$6.71
326,000 DWT	$6.15
500,000 DWT	$5.16

For the level of increased imports projected, considerable savings would be achieved by using the large ships.

With few exceptions, the maximum size ship that can enter U. S. ports is 65,000 DWT. The feasibility of constructing deep-water terminals in offshore coastal waters is now under investigation. A thorough analysis of environmental, economic, and technical aspects and alternatives will be completed before any decision is reached on constructing such terminals. From studies which have been conducted, it appears that the use of some type of deep-water port facility

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1/ Soros Associates, Inc., "Offshore Terminal System Concepts", September 1972.

could be the most environmentally acceptable method to handle increased oil imports. A deep-water port could be located outside of congested harbors and shipping lanes. This factor, combined with the replacement of 2-4 small tankers by one very large crude carrier, would reduce the possibility of collisions and hence a major oil spill. An offshore facility could be built so as to eliminate dredging and oil spills in environmentally sensitive estuarine areas.

Additional refinery capacity would also be required for handling the increased level of imports. Depending upon future balance of domestic and imported crude in the year 2000, it is projected that required percent growth of refinery capacity over 1969 capacity will range from 136-152%. 1/ It is anticipated that the requirements for future refining capacity can be met by modernizing existing refineries, buiding new refineries on original refinery real estate, building new refineries on land adjacent to existing ones, and, if possible, building new refineries along the supply pipelines, between the terminal and existing refineries. These options, especially the first three, require only a minimum of new land area which must be devoted to refinery space.

Oil would be moved from the terminal facilities to the refineries by way of pipelines. Environmental risks from these operations

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1/ Ibid.

would be those attendant to pipeline construction (as discussed in the sections on onshore and offshore oil and gas), and normal pipeline operations, e.g., pipeline leaks and more importantly, breaks from construction and anchor dragging. These risks can be minimized by clearly designating pipeline locations and by use of automatic shutdown equipment that would detect any sudden drop in pressure or discrepancy in totalizers (difference in amount leaving terminal and amount arriving at refinery or storage tank) on the line to first shut-off pumping equipment and then automatically closing sectionalized valves to minimize the quality of oil released.

(3) Pollution Potential at Loading Site

This alternative would result in increased potential pollution at the loading end (foreign ports) where pollution control standards may not be as stringent as United States standards. Therefore, this alternative would result in a potential net increase in pollution on world-wide basis although not directly affecting the shores of the United States except perhaps where oil products would adhere to parts of ship machinery and not be removed in transit, only to enter the water while docked in a United States' port. Offloading and onloading of oil raises and lowers tankers in the water by as much as 25-30 feet.

2. Increase Onshore Oil and Gas Production

a. Description of the Alternative

This alternative would require increased exploration, development and production of oil and gas from the Alaskan North Slope or from onshore sources in the lower 48 states. Increasing production, particularly gas production in the lower 48 states becomes a meaningful alternative only after positive steps have been taken to maintain present producing rates. Consideration must be given to the current low exploratory and discovery rates, high production levels and continuing declines in reserves and producing capacity. The time required to explore for and develop hydrocarbon production is also relevant as trends in exploration and discovery cannot be easily and quickly reversed. Development of North Slope resources cannot occur prior to the establishment of a transportation system.

Domestic development of oil and gas resources occurred initially onshore; offshore development is relatively recent but an increasing portion of domestic production is now coming forth from the offshore areas. In 1971, 12.03% of the domestic U. S. oil supplies and 12.18% of the domestic U. S. gas supplies came from the Gulf of Mexico. These figures can be compared with the OCS contribution in 1960 of 1.9% of oil supplies and 2.14% of gas supplies. This increasing offshore contribution to domestic production is particularly significant when viewed in terms of remaining

resources onshore and the changing relationship between offshore and onshore potential.

Proved reserves offshore total less than 5 billion barrels of oil and less than 40 trillion cubic feet (tcf) of gas compared with 33 billion barrels and 240 tcf onshore. (Onshore reserves include 9.6 billion barrels and 26.0 tcf on the North Slope of Alaska.) In terms of "indicated reserves plus undiscovered resources producible with current economics and technology," however, on and offshore potentials are more nearly equal - 171 billion barrels and 840 tcf offshore and 246 billion barrels and 1,260 tcf onshore. 1/

Potential onshore reserves, excepting the Naval Petroleum Reserves (NPR) No. 1 and 4 and the North Slope of Alaska, could be adequate to meet projected demands but recent drilling efforts have not resulted in discoveries sufficient to offset current production.

Proved crude oil reserves in onshore areas of the lower 48 states have declined by approximately three billion barrels within the period 1967-1971 even though recovery efficiencies have increased. During the period 1964-1971, cumulative demand for natural gas

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1/ USDI, United States Energy: A Summary Review, pp. 22 & 27.

totaled 152 tcf, or 19 tcf a year, whereas reserve additions only equalled 16 tcf a year. The ratio of reserves to production has fallen to about 8.9 for oil and 11.3 for gas.

Onshore geophysical work, leasing and drilling efforts have declined during the past decade. A number of factors, all adding up to insufficient economic attractiveness of onshore oil and gas ventures, have been cited for the decline. Probably the most significant of all is the increasing difficulty and cost experience by the industry in finding new oil and gas reservoirs sufficiently large to permit economic production. Only 30 new field exploratory wells were needed to find a significant field in the late 1940's; the number of wells required had nearly doubled by 1960 and this trend has not been reversed. 1/

The importance of finding large fields becomes apparent when it is noted that, in 1970, 63 percent of U. S. production was from only 264 of over 35,000 oil fields in the United States. 1/

The fact of the matter is that the onshore areas of the lower 48 states are mature producing areas where the most likely and easiest to find and develop oil and gas prospects have already been "picked over". Most remaining large fields will be more difficult and costly to find unless geologic techniques capable of identifying

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1/ Final Environmental Impact Statement, Proposed Trans-Alaska Pipeline, U. S. Department of the Interior, 1972, p. 320.

stratigraphic traps can be developed. Substantially improved economic incentives will be needed to bring these, as well as smaller fields, into production. Expanded application of stimulated recovery methods in existing or new wells is needed to maintain present production, let alone production increases. 1/ These methods are discussed in a separate section.

b. Incremental Production

The majority of additional production from onshore sources, other than the Naval Petroleum Reserves or the North Slope, will probably be obtained from areas not now deemed competitive. Some increase in the rate of exploration might be expected given a general rise in the prices of oil and gas. A general rise in price, however, would not alter relative economics between the OCS and other producing areas.

Additional production, resulting from increased exploration, will always be associated with a time lag. Periods of at least a year, and in many cases much longer, might be expected depending upon the location and complexity of the new producing area. The expenditures associated with additional exploration and development may be expected to be quite variable. It is reasonable to assume that this additional effort will be reflected in additional costs to the consumer.

Special and specific opportunities for increased onshore production may be found in Naval Petroleum Reserve (NPR) No. 1, California; in

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1/ Sutton, R. T. Commissioner of Conservation La.

NPR No. 4, Northern Alaska; and in other North Alaska areas including Prudhoe Bay.

NPR 1

Development of spare shut-in capacity in the Naval Petroleum Reserve No. 1, at Elk Hills, Kern County, California could provide as much oil production as is expected from the proposed OCS lease. Though the current producing rate at Elk Hills is less than 4,000 barrels a day, it is estimated that current facilities are capable of producing about 160,000 barrels a day. This rate could be increased to a range of 267,000 to 350,000 barrels a day with investment in additional drilling, producing equipment and transportation facilities. Congressional approval would be required for any appreciable increase over the current producing rate. Moreover, because of the distance involved, production from this area would not logically flow to those areas where Gulf of Mexico OCS oil production would be marketed. Again the oil produced here would not be fully substitutable for gas on a utilitarian basis.

North Alaska

The Prudhoe Bay field currently is estimated to contain 24 billion barrels of oil-in-place. At an estimated recovery rate of 40%, the current proved recoverable reserves of the field are 9.6 billion barrels of crude oil. 1/ These reserves alone make the Prudhoe Bay

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1/ American Gas Association, American Petroleum Institute, and Canadian Petroleum Institute, Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of December 31, 1970 (May 1971), p. 27.

field the largest ever discovered on the North American continent. 1/ Nevertheless, the 9.6 billion barrel estimate may be a conservative indication of the crude oil potential of the field and the Arctic Slope province.

The current reserve estimate for the Prudhoe Bay field is for unextended pools and assumes primary recovery only. With further developmental drilling and application of secondary recovery techniques, it is likely that at least 20 billion barrels of crude oil will eventually be recovered from the Prudhoe Bay field. This would make it the fifth largest oil field ever discovered in the world. 2/

The Prudhoe Bay field has large reserves of natural gas dissolved in or associated with its crude oil reserves. Recoverable gas reserves in the field were estimated to be 26 trillion cubic feet as of the end of 1970. 3/ An average of 750 cubic feet of dissolved gas per barrel 4/ for the current oil reserves of 9.6 billion barrels would indicate reserves of approximately 7 trillion cubic feet of dissolved gas and 19 trillion cubic feet of associated gas. These reserves,

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1/ Michel T. Halbouty A. A. Meyerhoff, R. E. King, R. D. Dott, Sr., H. D. Klemme, and Theodore Shabad, "World's Giant Oil and Gas Fields Geologic Factors Affecting Their Formation and Basin Classification, in Michel T. Halbouty, ed., Geology of Giant Petroleum Fields, Memoi 14, American Association of Petroleum Geologists (November 1970).

2/ Halbouty, et. al.

3/ Reserves of Crude Oil . . . p. 170.

4/ Suggested by the data given in Bureau of Natural Gas, Federal Power Commission, National Gas Supply and Demand: 1971-1990, pp. 98-99.

which, like the crude oil reserves of the Prudhoe Bay field, are subject to extension and revision, constituted 8.9 percent of recoverable U. S. natural gas reserves at the end of 1970. 1/ They also make the Prudhoe Bay field the 13th largest gas field ever discovered in the world. 2/ However, production of the gas would only occur after commencing production of the associated oil.

The estimated reserves of the Prudhoe Bay field do not exhaust the oil and gas potential of the Arctic Slope province in Alaska. The Prudhoe Bay field is located in the Colville Basin. Geologically, this basin is classified as an intermediate crustal type (i.e., its underlying crust is intermediate to that beneath continents and that beneath oceans), the basin itself being extracontinental (located on the margin of a continent) and sloping downward into a small ocean basin. Extracontinental, downward warping basins are among the richest sources of oil and gas in the world. Examples of such basins include the Arabian platform and Iranian basin (Persian Gulf), the East Texas basin, and the Tampico embayment (Mexico). Over half of the 119 known oil fields with at least one billion barrels of recoverable reserves are found in the 10 known basins of this type. 3/

1/ Reserves of Crude Oil . . . p. 124.

2/ National Gas Supply and Demand: 1971-1990, p. 74.

3/ Halbouty, et. al.

The ultimate potential on the onshore area in the Arctic Slope province is uncertain. The platform along the Arctic coast gives considerable geologic indications of being very favorable for both oil and gas. 1/ Comparison with the history of similar basins indicates a high probability of further discoveries of varying size. Professional estimates of ultimate recovery for the province range from 30 to 50 billion barrels. 2/ 3/ Considerably higher estimates than these have been made 4/, but the geologic evidence for them is lacking.

Similarly, the natural gas prospect of the North Slope are not limited to the Prudhoe Bay field. Several gas fields were discovered in the 1940's and 1950's on NPR-4, the largest of which was the Gubik field with 300 billion cubic feet of reserves. Geologic investigations

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1/ George Gryc, "Summary of Potential Petroleum Resources of Region 1 (Alaska and Hawaii) - Alaska, "and W. P. Brosge and I. L. Tailleur, "The Northern Alaska Petroleum Province, "in Ira H. Cram, etc., Future Petroleum Provinces of the United States - Their Geology and Potential, Volume 1, Memoir 15, American Association of Petroleum Geologist (1971).

2/ Ira H. Cram, "Future Petroleum Provinces of the United States - Their Geology and Potential: Summary" in Cram, ed., Future Petroleum Provicences. . . , p. 24.

3/ Sam H. Schurr and Paul T. Homan, Middle Eastern Oil and the Western World: Prospects and Problems (New York: American Elsevier, 1971), pp. 86-87. Personal communications with Richard Meyer, Office of Oil and Gas, George Gryce, U. S. Geological Survey, U. S. Department of the Interior.

4/ Governor Egan of Alaska was quoted in The Oil Daily (July 7, 1971) p. 3, with an estimate of 150 to 300 billion barrels.

of other parts of the North Slope have indicated a favorable potential for future gas discoveries within them as well. 1/

Under the Trans-Alaska Pipeline proposal, all of the North Slope oil to be transported by that line would be delivered to the West Coast (PAD V) within the first few years after full operation. Therefore, oil from that source cannot be considered an alternative for the proposed OCS lease sale since 99 percent of the oil from the proposed sale would be consumed outside PAD V. Deliveries of gas from other fields and by other transportation facilities are too remote and too conjectural for meaningful consideration in current planning.

Given the large size of the Arctic gas reserves and the projected shortages in other sources of domestic supply, there is high probability that this gas will be developed. Three different consortia have made proposals for gas pipelines down the Mackenzie Valley to these potential markets. However, many major uncertainties remain; for example, at this time industry experts differ in their opinions about how soon the gas caps in the Prudhoe Bay field can be tapped. Assuming 750 cubic feet of dissolved gas per barrel of oil produced, only 1.5 billion cubic feet per day of dissolved gas would be produced when oil production reaches a level of 2.0 million barrels

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1/ See "The Northern Alaska Petroleum Province."

per day. The additional gas required to meet the full planned pipeline capacity would have to come from the gas caps. The issue may not be fully resolved until several years after oil production begins, at which time empirical data on the effects of production of associated gas on the production of oil will be available. It is likely that a gas pipeline to the Midwest and lower Canada will ultimately transport gas from both the North Slope and the Mackenzie Delta region.

c. Technological Feasibility of Substitution

In general, maintaining and increasing the rate of onshore exploration and development for oil and gas will require new technologies in exploration and recovery. However, the incremental technology needed as an alternative to the volume of production anticipated from the proposed OCS lease sale may not be significant. Problems relating to substitution of energy forms would not arise.

d. Environmental Impact - Lower 48 States

Impact on Air Quality

The impact of additional petroleum production on air quality stems principally from the emission of particulates into the atmosphere; however, some disturbance results from noise and vibrations. Refining and petrochemical manufacturing as a result of increased oil production could contribute significantly

to the reactive hydrocarbon problem and consequently the petrochemical smog problem. However, all emissions must be within the Federal and State standards established by the Air Quality Act, and the Environmental Protection Agency standards for stationary sources under the Clean Air Ammendment (1970) to that act.

Particulates

Air quality in immediate areas of development will undergo some reduction because of removal of ground cover, dust from vehicle traffic, and from occasional equipment failure or blowouts. Such quality reduction is generally of a temporary nature and has a short-term effect.

Vapor venting from storage tanks and vessels, the burning of waste petroleum and chemical products, especially those containing some sulphur compounds, could result in increase of particulates in the atmosphere and objectionable odors. These impacts on the environment are also of a short-term nature.

Noise and Vibrations

Noise and vibrations from stationary engines used in drilling and production operations and transporting systems disturb the natural environment. The impact exists only for the time-frame that the engines are in use and are local in nature. Specific problems such as destruction of delicate geologic features, i.e. cavern

formations or natural arches, could be produced by thumper, vibrator, or explosive devices used in seismic exploration techniques.

Effects of Air Quality Reduction

It is highly unlikely that air quality reductions from operations associated with increased petroleum production would significantly alter conditions affecting the growth of flora. The feeding and nesting habits of birds and animals, wilderness qualities and hunting could be altered as a result of noise and vibrations associated with increased petroleum operations. After termination of operations, a reversion toward original conditions would be expected.

Impact on Land Quality

The modification of land form necessary for petroleum production results in varying degrees of environmental impacts on the physical and chemical land characteristics, biological conditons, cultural factors, and ecological relationships. In new onshore areas, new delivery systems would have to be built, the East Texas OCS already has some available transmission facilities.

Depending upon the terrain and local conditions, access to the land is normally from existing road networks, extension of these roads, and expansion of trails. For initial exploratory work, minimum alterations are made in roadway systems. After decisions are made to drill in a given area, an improved road system is required for the transportation of heavy loads. The drilling site must be cleared of vegetation which might present obstacles. Once production has been established, newly constructed roads are normally improved. From these operations environmental impact can result from removal of top soil and surface vegetation to establish right-of-way corridors and location sites, and alteration of drainage patterns and watershed cover.

In the construction of roadways, surface vegetation is removed and drainage patterns are modified. As a result, erosion can occur which would change the landforms. In addition to outwash, slumping and mudflows may result when the soil gradient is changed by road or drilling site construction.

Trees, shrubs, grass, and crops may also be subjected to indirect effects by modification of drainage patterns. In addition,

construction and exploration activity compacts the soil which is harmful to vegetation recovery. Although nature attempts to repair environmental degradation, external help may be required. Soil erosion and siltation can have both direct and indirect impact upon the normal behavior and activity patterns of wildlife. Small animals and birds may not be significantly affected, although their number in the immediate vicinity of the operations might decrease in proportion to disturbances and lost habitats. The habitat may be altered beyond the life of the producing and transporting operations.

Land use and recreation activities may also be disrupted during drilling, producing, and transportation operations. Aesthetic and human interest factors are affected for time-frames beyond termination of operations. For instance, caustic effects of drilling additives or saline fluids escaping from abandoned drill holes could be quite harmful to established land users. Scenic views and vistas, wilderness qualities, and physical features in some localities could undergo alterations that could be considered permanent transformations. Population density, employment, and cultural life-styles would change from drilling, production, and transportation levels. The change would be of long-term impact and directly affect access, utility networks, waste disposals, and creation of additional corridors. These effects would not necessarily be adverse.

While the construction of pipeline facilities has the potential for causing unfavorable environmental effects, the employment of good construction techniques can minimize or even eliminate most of these effects. Farming or grazing lands can usually be restored to their original condition after no more than one growing season by the replacement of top soil and the replanting of grass or crops. The aesthetics of wilderness areas can be preserved by using existing rights-of-way or minimizing the width of new rights-of-way, by replacing grass and shrubs on the rights-of-way, and by using such techniques as feathering and screening or deflecting entrance-ways. Any displacement of wild animals will occur only during the construction. Banks can and should be stabilized to avoid erosion during construction. Access and service roads should be maintained with proper cover, water bars and appropriate slope to avoid soil erosion. Compressor stations and other above ground facilities can be located in unobtrusive sites and planted with appropriate trees and shrubs to enhance their appearance; location, planting and exhaust design can be used to abate excessive noise associated with operation of the compressor stations. Treatment plants can be located and equipped with devices to minimize any adverse effects upon air quality and suitable means, e.g., evaporation ponds or disposal wells, can be found for preserving the water quality of the surrounding area.

A potential source of land pollution is a blowout during drilling but the frequency of blowouts is small. One hundred and six blowouts occurred in drilling 273,000 wells in 8 major oil producing states from 1960 through 1970. Most blowouts are from high pressure gas rather than oil. Other pollutants from blowouts are drilling mud and salt water. 1/

Impact on Water Quality

Access to Area

The construction of roads for access into prospective petroleum producing areas could affect water quality in that drainage patterns are disturbed and some erosion is possible. The dredging of canals could result in increased turbidity and resuspension of bottom sediments as well as salt water intrusion.

Production Operations

Entry of foreign substances such as oil, chemicals, brine, and waste materials into the water cycle is one of the major environmental risks associated with petroleum production operations. Spills or leaks allowing oil, brine, and waste substances to enter the water cycle can result from human error, corrosion of pipelines and vessels, ruptures or mechanical failures, burning pits, open ditches and blowouts.

1/ Environmental Conservation, The Oil and Gas Industries, Volume 1, June 1971, National Petroleum Council, p. 63.

During production, large amounts of salt water may be produced as gas fields age. Such water can create pollution problems from producing wells on land or freshwater-covered areas. According to a study of the Interstate Oil Compact Commission (IOCC), up to 25 million barrels of salt water are produced daily from the Nation's oil wells. Proper disposal of produced brines has been and continues to be of major concern to producing operators, and regulatory agencies. Subsurface disposal is strictly regulated by some state conservation agencies and disposal of salt water is not permitted in freshwater streams. 1/

Effects of Water Quality Reduction

Removal of vegetation, changes in drainage patterns, and erosion results in turbidity and siltation which reduce the water quality of reservoirs and estuaries. Turbidity is considered to be of short-term duration but may affect local flora and fauna. Siltation of water reservoirs and estuaries has long-range environmental impacts in that the shape and size of the water basin is altered. This can have an adverse impact on flora, recreation activities, aesthetic qualities and perhaps disturb ecological food chain relationships.

1/ National Petroleum Council, Environmental Conservation, The Oil and Gas Industires, Vol. II, 1972, p. 147.

The reduction of water quality and its attendant consequences through the introduction of oil, chemicals, brine, and waste materials into the water cycle ranks as a major environmental risk. The introduction of oil or brine into the water cycle can result in adverse conditions affecting trees, shrubs, grass, crops, and aquatic plants, birds, land animals, and fish. Sheltered lagoons and estuaries impose natural dispersal restrictions on oil spills causing the oil to remain trapped or concentrated in such areas for long periods. Consequently, in some localities, this adverse effect could be long-term. Generally, the degree of reduction in water quality will determine the duration of environmental impact. Inter-aquifer contaminations, i.e., a brine aquifer contaminating a fresh water aquifer, could substantially reduce fresh water resources in some areas and thereby become a health and resource problem as well as an environmental problem.

Land of Operations

Perhaps the greatest adverse environmental impact from operations results from oil, chemicals, brine, or waste material pollution. This pollution can result from spills, leaks, blowouts, human errors, or equipment failure. Although care is exercised to prevent land pollution, there are no fail-safe methods to completely protect the environment. For instance, considerable

oil production can result in land subsidence and if waste disposal is handled by pumping wastes back into wells the potential problem of inducing earthquakes is a consideration.

Land pollution operations, primarily salt water and accidental oil spills, can result in soil sterilization that could be of a long-term nature and affect not only the topsoil but underground water quality. Native vegetation and crops can be adversely affected for short or long-term duration depending upon the volume and toxicity of the pollutant, resistance of the flora, and the techniques and technology employed. Alterations of the flora in turn affect the habitat of birds and animals. Nature has a tendency to overcome the imbalance and in some cases can repair the environmental degradation. Depending upon the degree of pollution, land uses such as agriculture, grazing, forestry, and wilderness can be altered for varying time-frames. In some cases large pollutant concentration could be sufficient to kill vegetation, trees or crops and disrupt wilderness areas for long terms. Recreation in areas subjected to large pollutant concentrations can also be altered for long time-frames.

Depending upon local conditions, aesthetics such as scenic views and vistas, wilderness qualities, unique ecosystems, or historical sites and objects may be altered. The degree of

alterations would be dependent upon the degree of pollutant introduction and local conditions. Disruption of ecological relationships such as food chains, salinization of soil and water resources, could result from pollutant contamination. The degree of contamination has a bearing upon the term of environmental impact. Unexpected problems can develop in the most careful consideration of the environment, for instance, rupture of a high pressure oil pipeline by rifle fire.

In exploring and pipelining, any spills that occur normally would be small. Major spills could occur in drilling, production, and in the movement of petroleum liquids by marine transportation. The Federal Water Quality Administration (EPA) estimated that 10,000 oil spills occur a year of which 2,500 are ground spills. 1/ Most ground spills cause little ground pollution. According to the 1970 report of the Office of Pipeline Safety (Department of Transportation) on spill

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1/ National Petroleum Council, Environmental Conservation, op.cit. p. 146.

incidents, there was a total of 347 liquid pipeline accidents. In those accidents, spills averaged approximately 1,780 barrels of crude oil. Principal cause of over 50 percent of accidents was corrosion. Many onshore pipelines are old, dating back to 1920's before techniques for protection against corrosion became widely used. Continued accidents can be expected from these lines. With the development and expanded use of cathodic protection of pipelines, fewer accidents in new lines would be expected, but accidents from old lines will continue to be of concern.

3. <u>Increased Nuclear Power</u>

a. Description of the Alternative

The use of nuclear power as a commercial electrical energy source is expected to increase considerably in the next 15 years. Installed capacity is currently approximately 14,000 MW. The AEC projects capacity will increase to 52,000-57,000 MW by 1975, 127-144,000 MW by 1980, and 256,000-332,000 MW by 1985.

Most of the currently operating and planned nuclear plants utilize light water reactors. In the U. S. about 99% of electric power generated from nuclear fuel is produced by uranium dioxide fueled, light-water moderated and cooled nuclear power plants. In such reactors, the heat energy created in nuclear fission is removed by the circulation of water through the fuel core to generate steam to turn turbine generators to produce electricity. Seven high-temperature, gas-cooled reactors are also completed or on order. These utilize helium circulating through the fuel core. The heat produced is used to generate steam which turns the turbine generators. These reactors are all of the burner type which utilize less than two percent of the available energy from the uranium which they burn. Breeder reactors, which produce more nuclear fuel than they consume, such as the liquid metal fast breeder, are not expected to be available for commercial

use until the mid 1980's. Breeder reactors could utilize more than 60% of the total energy from uranium. Thermonuclear fusion reactors are not expected to be commercial reality until after the year 2000.

Almost all of the reactors in operation today are of the thermal type but considerable effort is being directed toward developing fast reactors which utilize more of the energy of the fuel material. Highest priority is now being placed on the development of the liquid metal fast breeder reactor and a commercial scale demonstration plant is to be built near Knoxville, Tennessee as a cooperative venture between industry and government. Construction will begin in 1974 and the plant is scheduled to begin operation about 1979 and is estimated to cost about $700 million. The first privately owned smallscale breeder reactor was built by a consortium of Detroit Edison and the Power Reactor Development Company about ten years ago. They failed to renew the operating permit and have filed a plan with the AEC in December 1972 to close the facilities.

b. Incremental Production

On the assumption that all of the oil and gas production from the proposed leases would be used to provide fuel for additional oil and gas fired power plants, five to six additional nuclear plants of 1,000 megawatts capacity each would have to be constructed and in operation between 1980 and 1985. This would be as much as two or more years later than the additional production would begin from the proposed OCS lease sale. 1/ This would represent approximately three percent increase in planned capacity.

The construction and operation of additional nuclear generating plants would require additional mining and milling of uranium ore to supply the fuel elements for these plants. An incremental operating capacity of 6,000 MW by 1985 would require 3,400 tons of U_3O_8 for the first core fuels and 1,000 tons of U_3O_8 for annual reloads without plutonium recycling and 800 tons of U_3O_8 with plutonium recycling. At an average ore grade of 0.20 percent U_3O_8 (or 4 pounds of U_3O_8 per ton of ore), a total ore output of about 1.7 million tons would be required to supply the uranium for the first core fuels, and an annual output of 0.4 million tons more would be required for reloads. As most of the known and

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1/ The proposed leases are estimated to provide 5-11 thousands bbls. of crude oil and 750-1050 million cu.ft. of natural gas per day six years after leasing.

potential reserves are concentrated in New Mexico, Wyoming, and the Colorado Plateau, incremental mining and milling activity would be expected to occur there.

Of uranium ore reserves at $8 a pound, about 44% is found in New Mexico, 39% in Wyoming, 4% in Utah, 4% in Colorado, and 4% in Texas, and the remainder is scattered throughout the western United States. Approximately 46% of current production of U_3O_8 comes from New Mexico, 26% from Wyoming, 12% from Colorado, and 7% from Utah.

The number of power plants in the planning or construction stage indicates that incentives to develop nuclear power facilities are already strong. The inability of utilities to obtain assured long-term supplies of oil and gas along with the environmental problems of coal-fired units has been the greatest stimulus to construction of nuclear plants. However, delays in equipment deliveries, public opposition, environmental objections, and legal difficulties have set back nuclear development.

Since planning, licensing, and construction lead times are at least eight to ten years, no new additional nuclear plants could be expected before 1980.

Future costs of electricity produced by nuclear power are difficult to predict on a long range basis. Factors that tend to lower costs include technological improvements, lower fuel expenditure over the life of the plant, larger plants with economies of scale, standard components, and improved construction methods. Large capital requirements make nuclear power plant costs sensitive to interest rates, taxes, and insurance. Construction delays can cause significant increases in capital costs. Because of the lead times involved, nuclear power plants built as alternatives to the proposed OCS lease sale would have to be planned and built with today's technology, the costs of which are well established. Nuclear plants are competitive with fossil fuel plants in most areas of the United States today.

c. Technological Feasibility of Substitution

Given the present energy-using technology, nuclear power can essentially only substitute for oil and gas used by electrical utilities and on-site heating facilities. Even here it is not a complete substitute. Nuclear power plants are designed primarily for base load operations and are not expected to dis-

place peaking or cycling units. Electricity produced from nuclear power also could substitute for household heating to the extent that heating oils and natural gas would come from OCS leasing.

d. Environmental Impact of Nuclear Power Generation

Environmental problems which could occur in nuclear power generation are associated with surface and subsurface mining of uranium ore, changes in land use, disposal of waste heat generated by less efficient nuclear plants, a small risk of serious accidents, and the safe storage of highly radioactive waste materials.

(i) Uranium Mining and Milling

Uranium mining is largely concentrated in relatively isolated semi-desert areas distant from large population centers. In the high plateau regions of the Rocky Mountain states, where most uranium mines and more than 90% of the ore reserves are located, the population density in the four state region encompassing most mining operations is 11.5 people per square mile. The removal of vegetative cover and the creation of overburden and waste rock result from uranium mining. In 1970, 53% of production came

from underground mines with most of the remainder coming from open-pit mines. Open-pit mines require considerable acreage, reducing the suitability of the area for other uses as grazing, wildlife and some types of outdoor recreation.

In underground mining, the extraction of ores requires some accummulation of waste rock in dump areas. Careful planning for sequential land use including reclamation of mined land and the backfilling of mined-out stopes and pits with waste rock, can substantially reduce land use problems.

Because of low concretation of U_3O_8 in uranium ore, milling the ore produces considerable amounts of low level radioactive tailings (the residue after extraction of U_3O_8 containing other radioactive elements) that must be retained in well constructed tailings dams to prevent erosion and leaching. Tailings are unsuitable for use as fill material where human exposure might result. To minimize erosion from above ground

storage, the tailings should be covered with gravel or dirt upon which a vegetative cover can be established. Above ground storage of tailings requires considerable land area and displaces other uses. In the future, an increasing amount of tailings may be utilized to backfill mined-out stopes and open pits. Mill tailings are a hostile environment for nearly all biota. The specific adverse effects on overall health of biota are not fully known; current evidence indicates increasing concentrations through upward stages of food chains.

(ii) Plant Construction

The impacts of construction of nuclear plants are identical to those of construction of fossil fuel plants. Assuming an average of three 1,000 MW units per site, the construction of 6,000 MW of additional nuclear capacity by 1985 could require two additional plant sites (less if some units were added to existing plants). Under current siting criteria, these would be located at some distance from population centers. Assuming 500 acres per site (based upon an exclusion area of one-half mile radius around each plant), these plants would require a total of up to 1,000 acres from which other uses would be excluded.

Depending on the capacity of the transmission lines which would be required if nuclear energy were to substitute for the production from the proposed OCS lease sale, the transmission line rights-of-way would require the use of ten to fifteen acres per mile of line. Certain types of development such as residences, would be excluded although such land would still be largely available for other purposes, such as recreation and farming. These additional transmission lines would have an adverse aesthetic impact by disrupting some scenic vistas. These impacts could be avoided by underground transmission lines. However, extensive research efforts are still required before many types of high voltage alternating current cables become available for general industry use. Construction of the plants would present some short-run environmental problems, such as the erosion of excavated materials. Special measures to prevent erosion of excavated materials with subsequent siltation will be taken.

(iii) Plant Operation

Operation of the nuclear plants will generate considerable amounts of waste heat given their comparatively lower thermal efficiency (around 33% compared to 40% thermal efficiency for new fossil-fueled plants). Given this difference in efficiency and on the assumption that fossil fuel plants release around 15% 1/

1/ Energy Research Needs, October 1971, Section 1X, Resources for the Future, p. 19.

of their waste heat directly into the atmosphere, a light water reactor would release approximately 50% 1/ more waste heat into its cooling water than a fossil-fuel plant of similar size. The environmental effects of this waste heat will depend upon the cooling method used and the location of the plant.

The use of wet cooling towers, removing the heat by evaporation into the atmosphere, would not pose the problems of adverse thermal effects on water sources used for "once through" cooling. However, water vapor from the cooling operations could have substantial effects on local haze, fog, cloud, and ice formation. Chemicals released in the cooled water or evaporated plume could also have effects on downstream and downwind biota.

The use of cooling ponds would produce less evaporation than wet cooling towers, but haze, fog, cloud, and ice formation would still occur during periods of sub-freezing temperatures. The ponds require additional acreage (an estimated 1,000-2,000 acres per 1,000 MW unit). These may have recreational uses, but they would also displace other land uses.

Assuming a 15-20 degree F temperature rise, a "once through" method of direct discharge into the original source for a 1,000 MW plant

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1/ *Ibid.*, Section VI, p. 15.

would require 270-360 billion gallons of water per year. The effects of using a "once through" method of cooling heated water depend in part on the size of the body of water into which this heated water is discharged. The effects along ocean sites, the Great Lakes, and very large rivers are likely to be modest as the heat is more readily dispersed and more easily avoidable by aquatic species. Along smaller lakes and rivers or in bays with limited circulation, the effects can be more significant. Within the affected areas, higher water temperature can produce fish kills, interfere with fish reproduction, disrupt food chains, decrease dissolved oxygen content, drive out desirable aquatic species and encourage the growth of undesirable algae which may speed up euthrophication. However, sometimes the heat can be used for aquaculture and other beneficial uses.

Nuclear power plants, unlike fossil fuel plants, do not emit the usual products of combustion such as particulates, sulphur oxides, and nitrogen oxides. Hence, they do not generate the air pollution problems stemming from or require control measures for, such emissions. However, they do produce radioactive emissions whose release must be strictly limited if adverse affects to the health of humans and other biota are to be avoided.

In the normal operation of the incremental nuclear generating units, there would be very small amounts of radionuclides discharged in the cooling water and gaseous plant effluents. Assuming that present standards will be maintained and enforced (these limit the release of radioactivity to no more than would expose an individual at the plant boundary to 1% of the individual maximums allowed), the effects of the amounts released are likely to be negligible, as the average additional annual dose which the nearby population would receive, would be three to four orders of magnitude less than the average level of natural radiation exposure.

The operation of nuclear plants poses some risk of accidents. Nuclear plants are designed to minimize accidents utilizing a "defense-in-depth" principle. This includes designing and constructing plants in such a way that accidents are prevented, designing and constructing plants to contain the effects of accidents which may occur, and siting reactors away from areas of high population density. Plants are designed to withstand a design basis accident (DBA), defined as the worst accident considered to have any significant possibility of occurrence. For light water reactors, the worst DBA considered is usually a major rupture in

the primary cooling system. The maximum radiation dose which could be received at the site boundary if such an accident were to occur is estimated for most plants not to exceed the annual dose obtained from natural radioactivity.

(iv) Transportation

The nuclear fuel cycle requires the transportation of radioactive materials by truck or rail at several stages. At the present time, about 500 truck shipments per year are required to meet the installed nuclear electric generation capacity. Most of the shipments contain low specific activity material. 1/ The transportation of spent fuel elements from

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1/ Environmental Survey of the Nuclear Fuel Cycle, AEC, November 1972, p. S-48.

reactors to processing plants and high-level waste from reprocessing plants to storage sites poses a potential hazard of considerable magnitude. Existing transportation regulations and cask designs have been developed to insure that even if accidents in transporting these materials do occur, no radioactivity will be released to the environment. It is estimated that 1.2 accidents involving truck shipments of non-enriched fuel cycle material could occur per 30 year lifetime of a model light water reactor. 1/ The low specific activity of the materials would limit the effects of a breach of containment to minor consequences. The likelihood of a criticality accident occuring during a truck shipment of fissile material is estimated to be infinitesimally small.

(v) Fuel Reprocessing

Spent fuel assemblies from reactors are first partially cooled at the plant site and then transported to fuel reprocessing plants where useable nuclear fuel materials are recovered from them and radioactive wastes are separated. Existing reprocessing capacity is sufficient to handle this relatively small incremental load as an alternative to the production from the proposed OCS sale. While radioactive emissions during reprocessing

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1/ Ibid., pp. 5-43.

are greater than those occurring during normal power generation, the estimated dose to the affected population is still two orders of magnitude below natural levels. Hence, the impact of these emissions is not expected to be significant, even though the chronic effects of such low level radioactivity are not yet wholly known. Further improvements will tend to decrease releases from these plants to very near those attainable at a single reactor.

(vi) Radioactive Waste Storage

The high-level radioactive wastes remaining after reprocessing are first concentrated and stored in solution for five years, then solidified, sealed in containers, and put into long-term storage.

The 6,000 MW of incremental capacity would produce around 48,000 to 64,000 gallons of high-level waste per year, using a cumulative storage capacity of 240,000 to 320,000 gallons. This liquid waste, when evaporated, would yield around 480 to 640 cubic feet/year in solid waste materials for each year of operation.

Because of their high concentrations of radioactive nuclides and very slow rates of decay, these waste materials must be isolated from the biosphere for hundreds of thousands of years if adverse

effects to living organisms are to be totally avoided. The concept of storage in salt beds has been termed satisfactory by a National Academy of Science Advisory Committee. Pilot studies have been conducted for several years and are continuing to determine the acceptability of the specific sites. In the meantime, waste will continue to be stored in below surface man-made engineered storage facilities.

4. Increased Use of Coal

Since coal is the most abundant fossil fuel in the Nation, full consideration must be given to its use in solid form. A later section discusses the feasibility of coal-based synthetic liquids and gases.

The major problems of increased use of coal as a solid fuel are those associated with the meeting of air quality restrictions. These are particularly significant relative to power generation uses since the largest market for coal is in the eastern portion of the Nation and the major deposits of low sulphur coal are in the western states. The Federal Government is contemplating a national standard that translated into 0.7 percent sulfur in the fuel for new plants regardless of ambient air quality. Assuming that the 0.7 percent sulfur standard becomes effective for plants built after 1972, and no major technological breakthrough materializes before 1980, then it would appear that all coals east of the Mississippi are precluded from the new utility plant market from 1972 onward. Furthermore, many states and cities have adopted regulations that apply to existing units as well.

Considerable research is being devoted to the development of economically feasible processes for the treatment of coal before burning to remove pollutants from stack gases after combustion. Where the quality standards can be met, coal can substitute for oil and gas at facilities designed to use solid fuels.

The following sections describe the problems related to the mining and processing of coal.

a. Description of the Alternative

The United States is well endowed in coal resources with its deposits underlying 458,600 square miles in 37 states. Coal resources remaining to be produced were estimated by the Department of the Interior in January 1972 at 3,200 billion short tons of which 2,800 billion short tons are at depths less than 3,000 feet, and 1,600 billion short tons are less than 1,000 feet below the surface. Only half of this would be recoverable and less than 5% of this half could be produced under both existing technology and economic conditions.

Of the gross reserve, approximately two-thirds have a sulfur content below 1 percent, but most of these are located in the Western United States and are lower in Btu or heating value.

Four-fifths of the North Dakota lignites have a sulfur content of 0.7 percent or less and nine-tenths have less than one percent. The sub-bituminous coals, 60 percent of which are located in Montana and Wyoming, rarely exceed 2 percent sulfur. Illinois, Indiana and Western Kentucky coals, which comprise 29 percent of our bituminous coal reserves, generally have more than three percent sulfur. Approximately 29 percent of our Appalachian coals have one percent or less sulfur with 42 percent containing between 1.1 to 3 percent sulfur. Most of the lower-sulfur Appalachian coals are metallurgical grade and generally not suitable for burning under boilers. 1/

The quality of coal has become increasingly important as restrictions are updated, and new regulations are imposed by local, State, and Federal Governments on the utilization of fuel containing excessive quantities of sulphur, nitrogen, and particulate matter. As a result of these restrictions, lower-sulphur coal, or coal containing less than one percent sulphur, is in great demand for power generation, steel, and manufacturing. Throughout the United States, fossil fuel consumers are being forced by public demand and law to use low-sulphur fuels.

1/ The Energy Crisis - An Overview - New York Department of Public Service, November 1972.

At present, the greatest need is for low-sulphur bituminous coal with a low ash fusion temperature for use in the power plants of the eastern United States. There is an acute shortage of this located within an economic shipping distance of the eastern power plants; however, there is an abundant supply of low-sulphur bituminous and sub-bituminous coal and lignite in the Rocky Mountain States. The following discussion will be directed toward that area.

The remaining resources of low-sulphur bituminous and sub-bituminous coal and lignite in the Rocky Mountain States were estimated to be 874 billion short tons as of January 1, 1967. 1/ Of this amount, 188 billion short tons are in beds ten feet or more thick found less than 1,000 feet below the surface. Recoverable resources are estimated at 440 billion short tons to a depth of 3,000 feet and 94 billion short tons to a depth of 1,000 feet. Since 1967, coal

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1/ Paul Averitt, "Coal Resources of the United States: January 1, 1967" U. S. Geological Survey, Bulletin 1275, p. 1, 1969.

production in the Rocky Mountain States has been about 100 million short tons. Therefore, it is assumed that 94 billion short tons are still available as of January 1972. 1/

Approximately 45 billion short tons of the recoverable resources could be extracted by open pit mining, 2/ and 25 billion short tons are sufficiently well known as to character, thickness, and tonnage as to be classified as reserves. 3/ In February 19, 1973, the Secretary of the Interior announced the suspension of issuing prospecting permits for coal under sections 2(b) of the Mineral Leasing Act, and all pending applications were rejected in order to allow for more orderly development of coal resources on public lands of the United States. Prospecting rights held prior to this directive or issuance of competitive coal leases under 2(a) of the Mineral Leasing Act are still permitted. This enters some uncertainty in the availability of coal reserves to near term market demand from Federal lands.

1/ Averitt, 1972, oral communication.

2/ Ibid.

3/ USDI, Bureau of Mines, "Stripable Reserves of Bituminous Coal and Lignite in the United States", Information Circular No. 8531, p. 15.

It is estimated that the East Texas sale will produce 5,000-11,000 barrels of oil per day and 750-1,050 million cubic feet of gas per day. The energy supplied by this sale would be equivalent, on an annual basis, to the energy produced by 13-19 million short tons of 11,000 Btu/lb. coal. In the five-year period from 1980 to 1985, production from the sale would supply the equivalent of from 65 to 95 million short tons of coal.

The coal resources of the Rocky Mountain States, if interchangeable for other energy sources, could be more than adequate to provide the energy needed; however, these resources are far removed by expensive transportation or transmission costs from the area that would be served by the expected Texas production. Other limiting factors are the degtee of substitutability of coal for oil and gas and the impact of developing a coal industry capable of producing an additional 95 million short tons of coal during the five-year period from 1980-1985.

At present, very large open pit coal mines may produce five million short tons of coal per year. Very large underground mines may produce 2 million short tons per year. In order

for the Rocky Mountain coal industry to produce the additional tonnage needed each year from 1980-1985, approximately 9 large underground mines or four large open pit mines, or smaller mines, or some combination thereof, would be necessary. Such mines could become operational only after considerable study of reserves, water supplies, constructing of utility and transportation facilities, and market requirements.

Finally, a labor force would have to be found and trained to produce the coal within the health and safety standards of the Federal, State and local governments.

About one-half of the remaining coal resources in the Rocky Mountain States are found in thick beds underlying the northern part of the Great Plains. The coal generally has a low ash fusion temperature, a low-sulphur content, a substantially reduced heating value, and high volatile matter content. These characteristics suggest that this coal would be preferred for power generation, gasification, and liquefaction.

The total remaining coal resources in the basins of the Rocky Mountains are very large, nearly as great as those in the Northern Great Plains, but extremely thick beds are a rarity rather than a common occurrence.

At a few localities within the Rocky Mountain States, deposits of metallurgical grade bituminous coal and anthracite are known and some are actively mined. Generally, the coal from these deposits is not suited for power generation, gasification and liquefaction.

The coal resources of both the Northern Great Plains and the Rocky Mountain basins are so large that the locations of open pit and underground mines would likely be determined by nearness to adequate water supplies, transportation facilities, and the plans for mine-mouth power plants. Extensive governmental ownership of the resources indicates that mining, rehabilitation, and environmental controls and procedures imposed on mining operations could be fully effective, since they would be administered in large part by the Department of the Interior and cooperating State governments.

(i) Use of Coal as a Solid Fuel

Recent environmental regulations applicable to new electric generating facilities restrict the emission of sulphur dioxide to 1.2 pounds per million btu of fuel as fired; for bituminous coal, this is equivalent to about 0.7 percent sulphur. It is necessary, therefore, to reduce the sulphur content of the coal prior to burning or to remove sulphur oxides from stack gases following combustion in order that coal may continue to be used for power generation.

Mechanical cleaning of raw coal is not a solution to the problem, since only a small fraction of American coals can be cleaned sufficiently to meet sulphur emission controls and standards. Mechanical cleaning affects only pyritic sulphur and leaves untouched the 40 to 60 percent of the sulphur that is bound in the organic structure of the coal. In addition, freeing the small particles in which pyrites occurs requires fine grinding prior to cleaning, which in turn adversely affects the cleaning efficiency and restricts the methods of cleaning that can be applied.

Coal, especially high-sulphur coal, is available in large quantities in close proximity to consuming markets. New coal burning plants could be built if air quality standards can be met but economics for coal desulphurization are marginal and optimistic assessments of economics are generally based on a substantial credit for sale of byproduct sulphur. Recently, the supply of sulphur has exceeded demand and the market cannot be expected to accommodate additional volumes from coal desulphurization.

(ii) Open Pit Mining

Near surface coal (0 to 200 feet) generally can be extracted by open pit or surface mining. This

method involves the removal of the top soil and rock (overburden) to expose the coal bed, removal of the coal, and replacement of the spoil material and, in some instances, replacement of the top soil. Usually this is accomplished by working in large parallel trenches using the overburden of the second trench, or cut, to fill the first trench.

Surface or open-pit mining of coal has become a major source of solid fuels and, unless restrained by environmental restrictions, all evidence indicates that this method will increase in importance. For example, in 1929, open pit coal production amounted to three precent of the total United States production. 1/ In 1969, however, open pit mining accounted for approximately 200 million short tons or 35.2 percent of the 560 million short tons total U.S. production. 2/ It is estimated that for the year 1971, the amount of surface mined coal will have increased to about 50 percent of total U.S. production.

1/ F. E. Cash and Bernewitz, "Methods, Costs and Safety in Stripping and Mining Coal, Copper Ore, Iron Ore, Bauxite, and Pebble." "Phosphate", USDI, Bureau of Mines, Bulletin 298, 1929, p. 9.

2/ J. J. Gallagher and L. W. Westerstrom, "Coal-Bituminous and Lignite", Minerals Yearbook. Bureau of Mines, 1969, p. 309.

The principal reasons for this growth are: (1) full production can be reached quickly, (2) the coal can be mined more cheaply, and (3) open pit mining is much safer than underground mining.

(iii) Underground Mining

Coal too deeply buried to be extracted by surface mining would be recovered by underground mining. Because most of the coal resources in the Rocky Mountain area are on public Indian, or State lands, environmental impacts can be minimized by effective enforcement of Federal and State operating regulations.

Exploration activity in the Rocky Mountain States has not been directed towards obtaining the data necessary to design efficient methods of underground mining the thick coal beds. Generally, exploration activities by industry have been directed toward develo ment of near surface reserves for open pit mining. Numerous questions concerning local geologic phenomena and mining conditions remain to be answered about the deeper resources before large-scale underground mines could be efficiently operated at most places. Principal among these are: roof strata thickness, composition, and strength; coal bed continuity, quality and thickness; bottom strata thickness and composition; and the presence or absence of fault systems, aquifers, or explosive gas-bearing strata. In addition to affecting mine safety and production efficiency, these geologic phenomena and mining conditions could strongly influence the environmental impact of large-scale underground mining.

Underground recovery of coal from beds less than ten feet thick averages about 57 percent 1/; however, as coal bed thickness increases above ten feet, the recovery percentage decreases drastically. This decrease is related to the equipment used underground, none of which has the capability of efficiently extracting coal from beds over ten feet in thickness. Equipment manufacturers have not been interested because of a lack in demand in designing machinery specifically for mining thick beds.

b. Incremental Production

Adequate coal reserves exist in the United States to fulfill that energy demand to be supplied by the proposed OCS lease sale.

c. Technological Feasibility of Substitution

Increasing coal production as an alternative to the proposed OCS lease sale would present no new technological problems; however, if the 13-19 million short tons of annual coal production required to replace the energy supplied by the East Texas sale should be furnished totally by surface mines, it is believed that from 3-4 mines of five million short tons annual capacity each would

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1/ R. L. Lowrie, "Recovery Percentage of Bituminous Coal Deposits in the United States", USDI, Bureau of Mines, 1968, p. 11.

be required. Currently, a mine of mine of this magnitude employs 610 persons with a capital expenditure of about $40,000,000. Therefore, in order for surface mines to supply the coal needed annually, 1830-2440 employees would be needed with a total capital expenditure of #120-160 million. 1/ This capital expenditure does not include the necessary financing for coal cleaning facilities.

If the East Texas sale is not held and if the Rocky Mountain States should have to produce an equivalent amount of energy from coal, the severe short-term environmental impacts of surface mining could be minimized by underground mining. The manpower requirements and capital expenditures, however, would be large. On the basis of an annual production rate of about 2 million short tons per underground mine, approximately 7-9 underground mines would be needed. Manpower for these operations would total from 4-5 thousand employees and capital expenditures would range from 168-216 million. 2/

1/ National Petroleum Council, Coal Task Group, "An Initial Appraisal, 1971-1985", U. S. Energy Outlook, Vol. II, 1971, p. 136.

2/ Ibid.

Even if such resources could be allocated to the production of low sulfur coal, that coal would not be able to substitute for gas in many end uses without large capital expenditures, if at all. Due to the bulk handling of coal and leftover ash problems coal has all but been eliminated from the household sector of the economy. Many commercial uses are locked into natural gas use, although increased electric power generation could be done with coal and the electricity so produced could feasibly substitute for gas in large quantities.

d. Environmental Impact

Open Pit Mining

There generally are no favorable environmental effects to be found in the immediate area surrounding a surface coal mine. There are many serious environmental problems that are directly related to open pit mining Principal among these are:

Open pit mining disturbs a considerable amount of surface acreage. As of 1967, it is reported that open pit coal mines

were responsible for 41 percent of the land disturbed by surface mining in the United States. 1/

Predictions regarding the total size of the areas which would be disturbed by the surface mining of nearly 19,000,000 short tons of coal are shown in the following table:

PRODUCTION BY SURFACE MINING METHODS

(BASED ON 1,800 TONS PER ACRE FEET)

(FIGURES BASED ON 19,000,000 TONS PRODUCTION ANNUALLY OVER 5-YEAR PR.)

Coal Bed Thickness (Feet)	Recovery Factor (1%)	Coal Avail. Per Sq. Mi. @ 80% Rec. (Tons)	Area Disturbed Annually (Sq. Mi.)	Area Disturbed (1980-1985) (Sq. Mi.)
10	80	9,216,000	2.1	10.5
15	80	13,824,000	1.4	7.0
20	80	18,432,000	1.0	5.0
25	80	23,040,000	0.8	4.0
30	80	27,648,000	0.7	3.5
35	80	32,256,000	0.6	3.0
40	80	36,064,000	0.5	2.5
45	80	41,472,000	0.4	2.0
50	80	46,080,000	0.4	2.0

1/ USDI, Surface Mining and Our Environment, A Special Report to the Nation, 1967, pp. 53-54.

Additional open pit mining sufficient to satisfy the 95 million short ton energy requirement between 1980 and 1985, could result in the disturbance, and the need for rehabilitation of as much as 6,720 acres of land.

Climatic conditions are extremely important in considering the rehabilitation of mined lands in the Rocky Mountain States. Obviously, without proper moisture, the reseeding of reclaimed lands would serve little purpose and erosion processes would soon destroy the contour of the rehabilitated lands. The following table shows the rehabilitation cost on a per ton basis for varying degrees of restoration.

ESIMTATED COSTS IN CENTS PER TON OF COAL FOR REGRADING, RESEEDING, AND REVEGETATING STRIP-MINED LANDS TO A PLEASING, NATURAL CONTOUR

Assumed tonnage of coal recovered per acre	Estimated costs of reclamation per acre (dollars)				
	$1,000	$2,000	$3,000	$4,000	$5,000
10,000	.10	.20	.30	.40	.50
20,000	.05	.10	.15	.20	.25
30,000	.033	.066	.10	.13	.17
40,000	.025	.05	.075	.10	.13
50,000	.02	.04	.06	.08	.10
100,000	.01	.02	.03	.04	.05

Disruption of the land surface by open pit mining, unless proper precautionary measures are implemented, has adverse impacts on the local environment, leisure time activities in the area, and nearby residential and industrial activities.

Most coal deposits contain contaminants and must be washed. It is assumed that under ideal conditions, a 5-percent washer loss would occur, creating the problem of disposal of approximately 4.5 million short tons of waste material (over 5 years). This problem may not be critical for surface mines where pits, from which the coal would be extracted, could receive this material. Ultimately, the mine pits would be backfilled, levelled, the top soil replaced, and the area reseeded.

Other problems related to surface coal mining are acid water developing in the open pits and in spoil piles, erosion of pits, and dust. Each of these problems can be handled effectively by requiring the mining companies to observe environmental regulations. However, if they are not handled properly, damage can occur to the local environment. Additionally, area downstream of the mine and processing plant could be adversely affected.

Surface mining operations also generate fairly significant volumes of noise and vibrations. Modifications of the habitat, alteration of ground cover, alteration of drainage systems, destruction of land

forms, and siltation of nearby streams may also occur. With the implementation of proper rehabilitation and environmental safeguards, the unfavorable impacts described can be reduced to short-term problems. Proper supervision within the scope of present environmental regulations would result in mined lands being returned to "as good or better than found conditions", in that some restored lands could lend themselves to recreational sites, lake impoundments for boating and fishing and picnic areas. The short-term economic and energy profits derived from surface mining can be realized without long-term degradation of the environment if there is complete cooperation between all companies, land owners, and governmental bodies acting in concert.

TRANSPORTATION

Once mined, the impact of coal production is still felt in the transportation to the market areas. One way to eliminate this impact is to situate new power plants at or near mine locations. The transport of electricity to the market areas by transmission lines causes fewer environmental problems than the transport of a vast quantity of coal.

If the transport of the coal itself is necessary, four systems would be available to the Rocky Mountain States. These systems are: trucks, railroads, conveyors, and coal slurry pipelines.

A fifth system, water transportation, may be discounted because of the lack of navigable waterways. Each system has advantages that make it economically attractive. Selection of a system would be strongly influenced by the distance to a utilization plant. Relative costs of coal transportation systems are given in an attached table.

Truck Transportation

Truck transportation is commonly used for relatively short hauls, as in supplying mine-mouth utilization plants. The roads are usually less than 5 miles long, on land leased by the mining company, and have little effect on the general public. In the Rocky Mountain States there are usually no intersections with public roads and the traffic is generally related to the mining operations. Trucks can transport ash and spent plant materials back to mine pits for disposal, thereby using the haul in both directions as well as solving a refuse disposal problem.

Transportation Cost in Mills Per Ton Mile

	Maddex 1/	Aude 2/	Wellman 3/
Ocean shipping	0.3-10		
Pipeline	1.5-10	3-7 (More than 50 miles no slurry preparation)	
River barge	2-4		
Railroad	4-15	4-9 (Unit train more than 400 miles)	
Truck	55-70	50-80 (One way haul with empty return)	
Conveyor belt		20-60 (Less than 15 Miles)	
Pneumatic			130 (600 tons per hour, 5 miles)

1/ Philip J. Maddex, and Ole Skaarup, "The Cost of Transporting Ores and Raw Materials in World Markets ", Mining Engineering, June, 1970, pp. 56-57.

2/ T. C. Aude, N. T. Couper, T. L. Thompson, and E. J. Wasp, "Slurry Piping Systems: Trends", Chemical Engineering, June 28, 1971, pp. 74-90.

3/ Paul Wellman and Sidney Katell. "Economic Evaluation of Pneumatic Transport of Coal at 200, 400 and 600 tons per Hour. Paper in Pneumatic Transportation of Solids, Proceedings: Institute of Gas Technology, Bureau of Mines Symposium, Morgantown, W. Va., October 19-20, 1965. Compiled by J. D. Spenser, T. J. Joyce and J. W. Faber, 1966, p. 184.

The impact of rial transportation varies to some degree with the types of motive power used. Diesel locomotives are sources of exhaust gas and noise pollution; electric locomotives are not sources of air pollution per se; however, the pollution source is the power station. Positive factors include the transporting of commodities to fulfill the needs of inhabitants in the area and haulage of ash and spent materials back to the mine pits for disposal.

Rail Installations

Rail installations can be constructed to lessen the impact on the environment. Riboon rail with thermite welded joints can be installed to reduce tract noise. Rights-of-way can be fenced for safety to animals and humans, with underpasses and grade separations provided for heavily traveled roads. Coal hoppers can be partially covered, or the coal can be sprayed to reduce dust loss in transit. Coal loading and unloading facilities can be designed to consider aesthetics. Cut and fill areas can be constructed with gentle slopes to permit the growth of vegetation and borrow areas can be covered with top soil and then revegetated.

Overland conveyor systems

Overland conveyor systems are used to transport coal from mine to preparation plant, from truck or railroad unloading hoppers to storage areas or bunkers and directly to some utilization plants.

Generally, these installations are short; however, they may be as long as 15 miles. Although conveyor structures and transfer point housings are obvious intrusions on open space vistas, this impact can be lessened through selective use of colors. Rights-of-way for conveyor installations require less land than either truck or rail rights-of-way and do not require the extensive cuts and fills needed by other transport systems.

The least obtrusive type of transportation system from both land use and visual standpoints, are coal slurry pipelines. Land surface requirements are minimal because the pipeline is buried and appears at the surface only at drainage crossings and pumping stations. Slurry preparation plants, pumping stations, and terminal coal dewatering and storage facilities are the only permanent structures. The pipeline, after burial, does not interfere with the free movement of vehicles, people or animals. The only noise sources are at the slurry preparation plant and at pumping stations. Dust problems associated with pipelines are confined to the slurry preparation plant where the coal is crushed, screened and stored and commonly employed suppression methods minimize this problem.

The major adverse environmental impacts of the transportation systems are air and noise pollution, safety, the amount of land required for rights-of-way, trash disposal and aesthetics.

Air pollution sources are exhaust emissions, road dust, and coal dust. The level of adverse exhaust emissions can be reduced through efficient engine maintenance; road dust can be reduced by haul-road surface treatment such as hard surfacing, oiling, or applying water-chemical solutions; and coal dust can be reduced by truck covers and spraying. Although mufflers can reduce the level of noise pollution, truck haulage, because of the large number of noise sources and frequent trips, is commonly recognized as the noisiest system of transportation. Truck haulage also requires the commitment of more land than any other coal transportation system.

Rail transportation systems using diesel locomotives are sources of air and noise pollutants from engine exhaust systems. Effective maintenance of engine combustion systems and efficient mufflers can reduce the air and noise pollution levels from these systems. Coal dust lost in transit can be reduced by using partially covered hoppers or by oiling the coal during loading. Dusting during loading and unloading can be reduced with a combination of dust suppression sprays and enclosed chutes or bins.

The right-of-way for a railroad constitutes a permanent commitment of the land surface to this use making it unavailable for other uses. Free travel of vehicles, people and animals across

the committed area is restricted. The potential for collisions with trains exists.

In the open or scenic areas, railroad rights-of-way may be considered as aesthetic intrusions, especially if large trestles, overpasses, or cut and fill areas are required. Cut and fill areas can be reclaimed as mentioned earlier. The visual impact of trestles, overpases, and other appurtenant structures can be minimized with effective combinations of eye-pleasing designs and unobtrusive colors.

Conveyor system installations likewise constitute a permanent commitment of the land surface and restrict free movement of vehicles, people, and animals. The right-of-way width is less than that required for truck or railroad transportation systems. Uncovered or partly covered conveyors allow loss of dust in transit because of exposure to winds, and falling material may constitute a safety hazard to persons or animals. Conveyor systems, fenced or completely enclosed, can reduce or eliminate these hazards. Conveyor support structures, either frame or suspension type, as well as the conveyors, are obvious visual intrusions. Color treatment of support structures, enclosures, and transfer structures can lessen this impact.

The principal impacts of coal slurry pipeline systems are: the permanent commitment of land; providing an adequate water supply; and water disposal. Large quantities of water, at the rate of one ton of water per ton of coal, are required to transport coal in the Black Mesa, Arizona, Pipeline 1/. In water deficient areas, this method may not be an efficient transportation alternative.

Water disposal problems at the terminus of a pipeline could have an impact on water quality if not properly contained or when not economically feasible to recycle the water for transportation purposes. Coal slurry destined for power, could be dewatered, the "spent" water used for cooling tower makeup, ash handling, and/or evaporated in disposal ponds. The Mohave generating station in Nevada is utilizing water from the Black Mesa Pipeline in this manner.

The disposal of solids and water removed from sections of a plugged pipeline could cause environmental impacts. Holding ponds, equal in capacity to the upstream pipeline, could be provided at pumping stations and at the coal slurry preparation plant for disposal of removed plugs. The water could be evaporated and the coal could be left in the impoundment unless provisions are made

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1/ J. M. Arnold, "Discovery and Development of Peabody Coal Company's Black Mesa Mine", Society of Mining Engineers and American Institute of Mining and Metallurgical Engineers, Preprint No. 69-F 349, 1969, p. 8.

for recovery. Compaction and sealing would prevent spontaneous ignition, erosion, and accompanying siltation of the coal left in impoundments. The surface of the impoundment can then be revegetated to prevent erosion.

MINING WASTE

Large volumes of waste are generated during coal mining and processing. The volume of mine waste depends on the type and characteristics of top and bottom strata, the continuity of a coal bed, the tonnage mined, the amount of waste material included, the specifications for which the coal is being prepared, and the efficiency of the processing equipment. Uncontrolled disposal of waste, especially that containing carbon and sulphur, constitutes a source of pollution. Water flowing over waste disposal areas may transport leached minerals to adjacent areas. Dust-size particles commonly are transported by winds to contaminate adjacent land. Noxious gases from burning waste may be hazardous to plants, animals and people. 1/

Waste disposal areas require a commitment of land resources and, if poorly constructed, present an unattractive appearance to

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1/ L. M. McNay, "Coal Refuse Fires, An Environmental Hazard", USDI, Bureau of Mines, 1970, p. 8.

viewers. Slides and slump failures, where waste is deposited on slopes, may not only adversely effect land and water resources but also create a safety hazard.

Construction of slurry impoundments on underlying previous bedrock may result in pollution of the ground water. Percolation through the base of dikes permits slurry water to reach downstream drainage systems. Unless measures are taken by coal operators to seal this type of disposal area , unfavorable impacts can continue for decades. However, use of appropriate treatment methods on the part of coal operators, coupled with effective enforcement of waste disposal regulations promulgated by State and Federal Governments, can minimize such effects on the environment.

There can also be beneficial uses of waste materials. The rock removed during mining may be used as landfill providing an effective method of disposal.

<u>Underground Mining</u>

Subsidence of the ground surface is common above any abandoned and some active coal mines. The amount of subsidence relates to the mining method employed, the amount of coal removed, the thickness of the coal bed, and the composition and strength of

rocks overlying the coal. Subsidence of large areas commonly destroys man-made structures and disrupts the ground water hydrology, cuts off surface and subsurface water recharge, adversely affects the quality of undergound and surface waters, redirects the planned drainage of a mine, disrupts surface drainage, and in periods of heavy rainfall localizes flooding. It also, in some localities, causes land slides.

The most successful method of preventing or alleviating surface subsidence problems is to plan mining so that more pillars are left untouched. Unfortunately, this procedure results in less coal recovery. Pillars can be constructed of timbers and rock to make possible the mining of more coal than by simply leaving coal pillars in place to support the roof. Much additional research is needed to develop methods of underground mining which will minimize subsidence of the surface. If such methods cannot be implemented, the best solution may be to achieve as complete recovery of coal as possible during mining, then allow controlled subsidence to the point of natural stabilization and, finally, develop the land surface.

Ground and surface waters entering active underground mine workings are normally pumped to the surface for disposal. Because of the low-sulphur content of most Rocky Mountain coals, it is uncertain whether acid-mine water would be a problem in areas of large-scale mining and above average precipitation. If acid-mine water problems should develop, it is likely that the modern treatment methods employed in the coal fields of the eastern United States could be implemented to abate their impacts. The large volumes of sludge resulting from such treatment could be emplaced either in abandoned mine workings or in protected disposal areas. Drainage of acid-mine water may be prevented by locating mine entries at elevations above the prevailing drainage level, by sealing abandoned mine entries, and by emplacing dams at critical points in abandoned underground entries and haulageways.

Unless controlled, mining and processing wastes contribute large volumes of sediment to nearby streams, are sources of acid drainage and, where waste piles are burning, are sources of air pollution. The most commonly used technique of preventing widespread scattering of mining and processing wastes is to compact the waste layers, followed by sealing with incombustible soil, after which vegetation is established to prevent infiltration of surface water and to minimize erosion.

An alternative to surface disposal of mine and coal processing waste is to return wastes to abandoned underground mine workings. This is currently being done to control surface subsidence in mined areas in compliance with restoration provisions of the Appalachian Regional Development Act of 1965, as amended. 1/ Methods of returning the waste to mined out areas concurrent with active mining would appear to warrant attention of mining method researchers.

Dust from mine access roads, coal handling, and processing can be alleviated by hard surfacing roads, or through abatement techniques such as oiling or chemical treatment of the road surface. Dust from coal handling and processing can be abated by spray treatment at transfer points and by enclosing coal handling and processing structures. Dusting problems in live coal storage piles can be reduced by water sprays or oiling; dead storage piles can be sealed with asphaltic or chemical materials.

The potential for long-term environmental impacts from an underground mine can be diminished by identifying and eliminating pollution sources prior to closure of the mine. Most pollution sources can be eliminated by sealing and revegetating waste

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1/ C. B. Kenahan and E. P. Flint, "Research and Programs on Recycling and Disposal of Minerals, Methal and Energy-Based Solid Wastes", USDI, Bureau of Mines, 1971, p. 24.

disposal areas; sealing and removing abandoned mine buildings and structures; and scoring, fertilizing, and revegetating disturbed surface areas. Consideration should also be given to flushing all wastes and plant refuse into underground mine voids to remove sources of surface pollutants and to reduce possible surface subsidence.

A discussion of the favorable environmental effects of underground mining follows:

When subsidence of the land surface is prevented, the surface effects of underground mining generally are confined to the areas occupied by mine buildings, dumps waste disposal banks and impoundments, water supply impoundments or wells, coal transportation systems, power supply structures, and mine supply storage yards.

The areal extent of environmental impacts associated with underground mining is dependent on the mining system being designated to assure a high level of environmental quality. Means of obtaining this assurance are State and Federal regulations, and the development of an environmental ethic by all mine operators. The Mined Area Protection Act of 1971 (S. 993 and H. R. 5689), currently being considered by the 92nd Congress, is an example of pending legislation that would require all underground and surface operators to adhere to standards designed to protect the environment.

Several provisions of the mandatory safety standards issued under the Federal Coal Mine Health and Safety Act of 1969 have related environmental objectives, especially those standards for disposal of mine refuse and dust, for coal handling, and for transportation facilities.

Most older coal leases on Federal lands include a provision in the lease agreement for the protection of the land surface, natural resources, and improvements. This provision has been broadened over the years to include environmental considerations.

Underground mining is subject to minimal noises and vibrations and the surface environmental effects are of limited significance. Modifications of the habitat, alteration of ground cover, alteration of surface drainage systems and the necessity of fertilization application are also minor. The following environmental effects of underground mining, however, pose problems: alteration of ground water hydrology, the necessity of well drilling and fluid removal, the techniques of product processing and resultant waste, liquid effluent discharges and most accidents.

Many unfavorable environmental impacts of underground coal mining can be controlled largely through techniques developed and used in recent years. Prevention of environmental degradation by underground mining is dependent upon attitudes of mine operators and efficient enforcement of local, State and Federal regulations.

e. Health and Safety

Costs in terms of health and safety of mine employees must be considered along with the capital expenditures and environmental costs of mining.

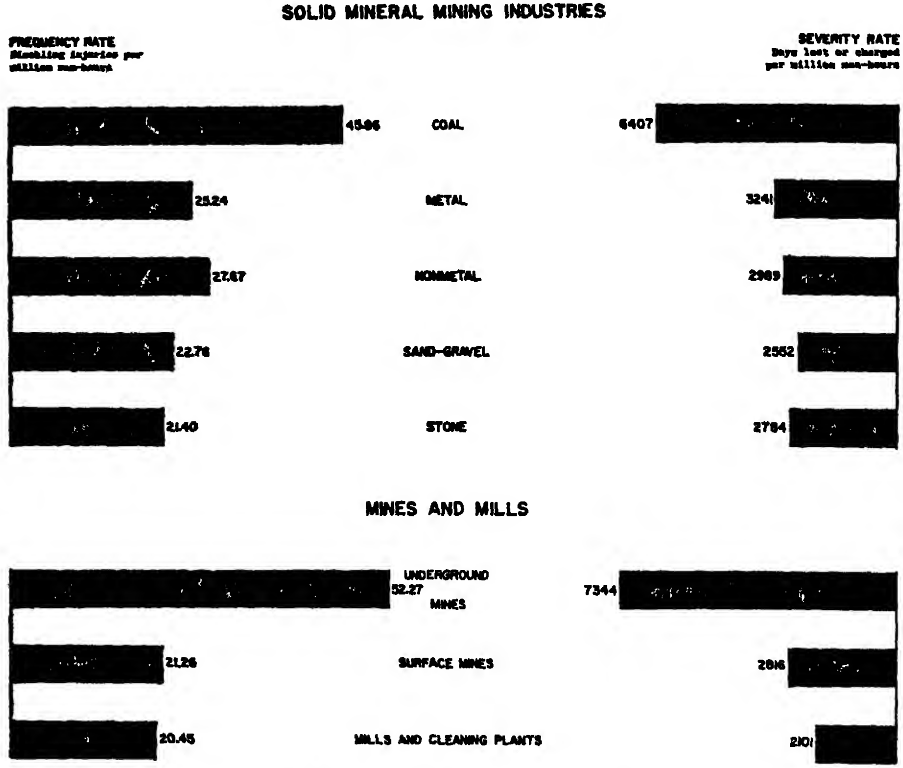
In 1970, there were 31 fatal and 1,010 non-fatal accidents connected with open pit mining. Underground mining was responsible for 219 fatal and 8,710 non-fatal accidents in 1970. These figures may be compared to the 15 deaths and 81 injuries associated with offshore production in the Gulf of Mexico in 1971.

Black lung disease has been a serious problem in the past. Recent regulations and technological advances concerning the control of the quantity of dust in mining operations, however, hopefully will go a long way to reduce or eliminate this coal mining associated health hazard.

The safety record of the solid mineral mining and milling industries is illustrated on the following page, demonstrating the severity of the coal industry safety record in relation to other mining industries, as well as the safety record of surface mining in relation to underground mines.

INJURY EXPERIENCE AND WORKTIME, IN THE SOLID MINERAL MINING INDUSTRIES, 1970-71

The safety record of the solid mineral mining and milling industries in 1971 was 342 fatal and 23,530 nonfatal injuries at respective frequency rates of 0.44 and 30.59 per million man-hours and a severity rate of 4,056 days lost or charged per million man-hours for all injuries.



Injury rates of the solid mineral mining and milling activities in 1971.

Prepared by Forrest T. Moyer, Health and Safety, Bureau of Mines, August 1972.

5. Increase Hydroelectric Power

a. Description of the Alternative

The generating potential of any hydroelectric site is a function of both stream discharge and the height of fall; hence the better hydroelectric sites are concentrated in areas with heavy precipitation and large topographic relief. The following table shows the extent of U. S. potential and development of conventional water-power capacity:*

Geographic Region	Potential Power (10^3 MW)**	Percent of Total	Developed Capacity (10^3 MW)	Percent Developed
New England	4.8	2.7	1.5	31.3
Middle Atlantic	8.7	4.8	4.2	48.3
East North Central	2.5	1.4	0.9	36.0
West North Central	7.1	3.9	2.7	38.0
South Atlantic	14.8	8.2	5.3	35.8
East South Central	9.0	5.0	5.2	57.8
West South Central	5.2	2.9	1.9	36.5
Sub-total	52.1	28.9	21.7	42.0
Mountain	32.9	18.3	6.2	18.8
Pacific	62.2	34.6	23.9	38.4
Alaska	32.6	18.1	.1	0.3
Hawaii	0.1	0.1	-	-
TOTAL	179.9	100.0	51.9	28.8

Of the potential hydroelectric capacity of 179,900 MW in the U. S., 95,400 MW is yet to be developed in the lower 48 States. Of this, 30,400 MW is the potential for additional hydropower east of the

* Statistics as of January 1971 obtained from FPC.
** MW = Megawatts

Mountain States. Hydropower from Alaska, the Pacific or Mountain areas of the U. S. probably cannot be considered as sources of additional hydropower for the Eastern U. S. largely because of the distance from consuming region and the related transmission problems making development uneconomical.

b. Incremental Production

The Federal Power Commission projects conventional electric generating capacity in the contiguous U. S. as follows:

Year	Total Generating Capacity (MW)	Total Conventional Hydro Capacity (MW)	Conventional Hydro as Percent of Total
1970	340,000	51,600	15.2
1980	665,000	68,000	10.2
1990	1,260,000	82,000	6.5

The geographic distribution of the projected 16,400 MW increase in conventional hydro capacity in 1980 over the 1970 capacity for the contiguous U. S. is as follows: 1/

Geographic Region	Incremental Hydro Capacity (MW)
Northeast	1,200
East Central	1,000
Southeast	1,700
West Central	- 500
South Central	700
Sub total	4,100
West	12,300
TOTAL U.S.	16,400

1/ Federal Power Commission, The 1970 National Power Survey, Part 1, p. 1-18-29.

Of the total incremental conventional hydroelectric capacity of 16,400 MW, 4,100 MW can be expected to come from areas other than the West, leaving some 25,000 MW to be developed in those areas. If all of the remaining potential 25,000 MW were developed by 1980, hydropower might approximate the energy value of the proposed East Texas sale.

c. Technological Feasibility of Substitution

Full direct substitution of hydroelectric power for oil and gas to be produced from the East Texas sale would not be possible since at least 50% of the oil is for transportation, a use which cannot be supplied by hydropower. However, refinery yields of products, overall, could readily be modified to accommodate this substitution. Other considerations restrict the feasibility of this alternative. The economic feasibility of the undeveloped hydropower has not been demonstrated, and land use considerations may preclude development at many cites. Furthermore, few dams are built solely for hydroelectric power generation. Irrigation, navigation, municipal and industrial uses, and flood control are important, and frequently are the dominant uses which may not be fully compatible with power production needs.

d. Environmental Impact

A number of environmental impact statements filed by the Bureau of Reclamation of the Department of the Interior and by the Corps of Engineers describe environmental impacts of specific hydroelectric projects.

Hydroelectric power produces no air pollution, radioactivity, nor waste heat. Dams valuable for hydroelectric purposes may be otherwise useful for such needs as irrigation and flood control. Lakes behind dams created for hydroelectric purposes provide recreational opportunities such as swimming, fishing and boating.

However, construction of a hydroelectric dam represents an irretrievable commitment of the land resources beneath the dam and lake, precluding other uses (agriculture, minerals, wildlife habitat, free-flowing river recreation, and so forth). Alteration of river flows may lead to silting behind the dam, thus progressively reducing reservoir capacity and its effective use and finally, after many years, filling the lake. Alteration of downstream flows from power-plant discharges can cuase scouring of banks and bottoms.

Fish and wildlife habitat may be significantly changed. The reproductive habitats of anadromous fish may be severely altered by dam construction, unless elaborate provision is made for fish ladders or other means to provide safe fish passage. Significant mortalities of resident and anadromous fish in rivers servicing hydroelectric dams can be caused by gas-bubble disease resulting from exposure to dissolved gas supersaturated water. Dissolved gas supersaturation results at a dam when excess river flow must be passed over the spillway.

Survival studies conducted in 1971 indicate that high dissolved gas levels in the Columbia and Snake Rivers pose a serious threat to the future of the salmon and steelhead resources of the region. 1/ Subsequent to 1971, the Environmental Protection Agency has determined that other dissolved gases supersaturated in water as well as nitrogen cause problems with anadromous fish. Under present plans to expand the Columbia Basin hydroelectric system through 1980, the volume of spills at the various projects will be reduced. However, without additional control measures, the reduction in volume of spills will not be great enough to reduce dissolved gas supersaturation to levels considered safe for fish during years of average or higher flows.

The Corps of Engineers is actively engaged in studying and testing several approaches to the solution of the dissolved gas problem. Efforts have been concentrated on manipulation of storage, full use of generating units, slotted intake gates, collection and transportation of downstream migrants, and spillway modifications.

1/ Power Planning Committee, Pacific Northwest River Basins Commission, Review of Power Planning in the Pacific Northwest, Calendar Year 1971, pp. 71-76.

6. <u>Modification of FPC Natural Gas Pricing</u>

This alternative as it appeared in the draft environmental statement was commented upon by Thomas J. Joyce, Chief of the Bureau of Natural Gas, Federal Power Commission at the hearings on the proposed sale. His testimony has been incorporated herein to the extent possible. In addition, FPC staff has provided informal assistance and consultation.

a. Description of the Alternative

The sale of natural gas for resale in interstate commerce in the United States is under FPC jurisdiction. Under this alternative FPC would permit interstate gas prices to rise to the extent needed to attract additional investment in domestic oil and gas exploration and development, onshore and offshore, to provide additional supplies of natural gas equivalent to supplies coming from the proposed sale.

In 1954, the Supreme Court ruled that independent producers of natural gas, whose sale of gas goes into interstate commerce were not exempted from regulations under the Natural Gas Act. Since then, terms of interstate gas sales for resale, including pricing, have been subject to Federal regulation.

In 1960 the FPC departed from an individual company "cost-of-service" method price determination in favor of an "area rate" concept. The area rate method which has been upheld by the Supreme Court, involves the accummulation of data sufficient to determine the average unit

costs associated with all aspects of natural gas production on an areal basis, instead of examining the costs of each producing company.

Recently, the FPC has modified its pricing policies to be more responsive to the current gas supply situation. Some FPC area price ceilings were raised about 35 % during 1968-70, and still more recently the Commission has initiated major actions to stimulate natural gas exploration and development.

On July 16, 1971, FPC Opinion No. 598 set new, higher ceiling rates for the South Louisiana area and provided for a system of incentives to promote dedication of gas reserves to the interstate market. In support of its price action, the Commission observed that demand for gas as a "pollution-free fuel" is increasing and the price of alternative fuels is going up. It further concluded that there is "a worsening gap between supply and demand, and that price must have a major responsibility for eliciting new supplies".

Similar higher ceiling prices were later granted in other major gas producing areas.

In furtherance of the concept of providing incentives, the Federal Power Commission in Order No. 455 dated August 3, 1972, offered an optional procedure for certificating new producer sales of natural

gas. Under this option, sales of new gas at prices above existing ceilings, agreed upon by buyer and seller, may be certificated subject to certain constraints and possible future actions by the Commission. This alternate procedure is designed to assure interstate gas consumers, and the nation as a whole, an adequate and reliable supply of natural gas at the lowest reasonable cost. It is not intended to replace geographical area pricing, but rather to provide an alternative procedure for certification of natural gas sales for new gas sales at rates above established area ceilings. To date, approximately twenty-three applications have been filed under Order No. 455. Other developments under this order include the hearing which concluded on March 27, 1973, to determine whether it is in the public convenience and necessity to issue certificates to three producers to sell gas from offshore Louisiana at 45¢ per Mcf.

On November 8 and 9, 1972, the FPC issued notices of proposed rulemakings in Docket Nos. R-458 and R-459 respectively. The first proposed a new policy under which it would consider applications by independent producers for special relief from area rate ceilings with respect to sales from reservoirs where reduced pressures, a need for reconditioning wells or deeper drilling render further production uneconomic at existing prices. The second recent proposed rulemaking in Docket No. R-459 would give special rate relief to producers in order to encourage the recovery of gas presently being flared or vented.

An additional policy enacted by the Commission to elicit increased gas supplies, though not price-related, concerns advance payments to provide for rate base treatment of advances made by pipelines to suppliers of gas to be delivered at a future date. That policy has been affirmed after court review. Advance payments for lease acquisition continue to be excluded from rate base treatment by Order No. 465, dated December 29, 1972, but advances for exploration are currently being allowed. As of August 31, 1972, about $1.25 billion in such payments have been committed by interstate pipelines. In the December 1970 Louisiana Gulf Coast area offshore lease sale, about $300 million of the $846 million in bonus bids was supplied by pipelines. In a separate action, the FPC issued notice of a proposed rulemaking to consider the question of advances made to producers operating outside the lower 48 states.

The Commission has also taken many other steps to mitigate the shortage of gas, including Order No. 402, concerning emergency gas sales, and implementation of a National Gas Survey to provide data for long-range planning.

Thus, the FPC has modified its pricing to be more responsive to the supply situation, short of deregulation. In the hearing on the proposed sale, an FPC witness stated, "these actions, however, are intended to operate in concert with increased leasing, not to replace it. The increased availability of public lands for gas and oil

production is one of the pre-requisites for the success of many of these reports". 1/

The Department of the Interior, as well as other government agencies and Congress have been considering deregulation of the wellhead price of natural gas. No final actions have been taken to date, however. In his testimony at the hearing on the proposed sale, Dr. John McKetta stated,

> "The U. S. Government should immediately remove all price controls on interstate gas and let the marketplace establish a price level under a normal supply-demand basis. This will provide a great incentive for people to borrow more money to drill more wells. This will aid greatly both gas and oil discovery (and production).
>
> Unfortunately, many people believe that a mere increase in the price of gas would solve the entire natural gas shortage. This shortage will never be solved; however, we must try to alleviate it somehow . . . Of the unproved reserves, 70% are estimated to be located beneath the Outer Continental Shelf.
>
> Unfortunately, most of the U. S. gas fields are now harder to find, are much deeper, and cost much more for drilling. . . We have no reliable information to predict the increase in the amount of drilling and the finding of gas as a function of the increase of price." 2/

1/ Testimony of Thomas J. Joyce, Chief, Bureau of Natural Gas, Federal Power Commission, presented at the 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale Hearings, February 21 and 22, 1973, Houston, Texas.

2/ Testimony of Dr. John J. McKetta, Professor of Chemical Engineering, University of Texas at Austin, presented at the 1973 Outer Continental Shelf, East Texas General Oil and Gas Lease Sale Hearings, February 21-22, 1973, Houston, Texas.

b. Incremental Production

In order to replace the amount of oil and gas expected to be produced from the proposed sale, the equivalent of an additional 780 to 1115 million cubic feet of gas per day would have to be stimulated through higher prices.

Several studies have been made on gas price - supply elasticity, all showing gas supply responding to price. Differences exist in the amount of increase in price and the corresponding increase in volume, but results indicate that a significant increase in price could offset the equivalent production from the proposed OCS lease sale.

The actual relationship between natural gas supply and price can only be determined by actual experience. Uncertainties involving investment responses and discovery rates inhibit meaningful projections of price/production relationships. While the incremental prices relevant to this specific proposed sale may be relatively small, it must be noted that the size of the required price increase would be related to the quantity of available oil and gas exploration prospects. If this and subsequent offshore lease sales are not held to make prime prospects available, requisite prices will be higher than if the offshore leases were made available for leasing.

c. Technological Feasibility of Substitution

Of the additional 780 to 1115 million cubic feet of gas equivalent per day that would have to be produced as a result of the implementation of this alternative, 30 to 65 million cubic

feet a day would have to substitute for the oil that is expected to be produced per day as a result of the sale. As some incremental oil production may result as a by-product of increased gas exploration, the actual required substitution of gas for oil could be somewhat less than 30 to 65 million cubic feet a day. In any event the substitution of gas for oil is small enough, relative to total oil usage, that it could be accommodated through changes in oil products yields at refineries.

d. Environmental Impact

Specific environmental impacts and effects on health and safety are not listed in this section because they are similar to the effects of increased production from onshore and offshore areas discussed elsewhere.

7. <u>Oil Shale Production</u>

a. Description of the Alternative

Large areas of the United States are known to contain oil shale deposits but those in the States of Colorado, Utah and Wyoming are of greatest potential for commercial shale-oil production. It is estimated that some 73 percent of oil shale lands containing nearly 80 percent of the shale oil is on public lands. The highest grade deposits occur over an area of 17,000 square miles (11 million acres) and contain an estimated 600 billion barrels of oil. Recovery of even a small fraction of this resource would provide significant amounts of clean energy adequate to supplement the Nation's oil supply for many decades.

Three retorting processes have been developed to the point of technogical practicability, but none has been demonstrated and tested at a commercial production scale. The mining of the shale presents no particularly difficult technological problems as it can be done by conventional room and pillar underground mining or by surface mining techniques. The major process barriers to development of this alternative therefore are the need for full-scale demonstration and testing to prove the technology and develop necessary cost and other data for determining economic feasibility.

On June 29, 1971, the Secretary of the Interior announced plans for a proposed prototype oil shale leasing program which is designed

to ". . . provide a new source of energy for this Nation by stimulating the timely development of commercial oil shale development by private enterprise, and to do so in a manner that will assure the minimum possible impact on the present environment while providing for the future restoration of the immediate and surrounding area." The proposed program would make available to private enterprise, for development under lease, a limited amount of public oil shale resources. Such leases would be by competitive bonus bidding and would include assumption of certain royalty obligations to the United States.

The proposed program is in concert with the President's Energy Message of June 4, 1971, in which he requested the Secretary of the Interior to initiate "A leasing program to develop our vast oil shale resources, provided that environmental questions can be resolved." The environmental question has come under intensive review over the past 3 years and, in September, 1972, the Secretary released a 1,300-page draft environmental statement. 1/ That statement details the proposed program and assesses the specific impacts expected from prototype development plus development on private lands that may be stimulated by the Department's action should the program be implemented.

1/ "Draft Environmental Statement for the Proposed Prototype Oil Shale Leasing Program", released September 7, 1972 by the U. S. Department of the Interior in three volumes.

b. Incremental Production

The proposed prototype program depends on industry as to the timing of commercial production. It is not possible therefore, to determine the exact amount of oil that is to be expected in the future. For planning purposes, however, it is necessary to determine the maximum rate of development that may be expected. This was done for the Department's study 1/ and the estimates are quoted as follows:

> Commercial shale-oil production, under the most optimistic estimate, could begin about 1975 at a rate of about 18 million barrels per year (50,000 barrels per day), on the basis of anticipated technologic progress. The first generation technology needed for this rate of production would be improved from 1976 to 1980. This development stage will be reflected by only small increases in annual production of about 18 million barrels per year as the new technology is applied. By 1980 a productive capacity of more than 100 million barrels per year (300,000 barrels per day) could be established. More importantly, the technology probably will have been advanced to the point where large incremental increases in production could be achieved. Also, the nucleus of people, supporting

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1/ "Draft Environmental Statement for the Proposed Prototype Oil Shale Leasing Program", released September 7, 1972 by the U. S. Department of the Interior in three volumes.

services, facilities, and experience needed for this expanded effort will have been established.

After 1980 the second generation extraction-retorting systems would be expected to permit annual additions to shale-oil productive capacity of about 37 to 73 million barrels per year (100,000 to 200,000 barrels per day). The rate at which oil shale may be developed provides the framework for subsequent calculations of the capital investments that will probably be required. Seven installations with a cumulative capacity of 400,000 barrels per day are assumed to be constructed on both private and public lands in the period 1973 to 1981. In the period 1981 to 1985 capacity is assumed to grow to one million barrels per day.

The cumulative 6-plant capacity of 300,000 barrels per day by 1979 reflects the necessary construction and evaluation phase of this new technologic development. Second generation technology could be expected to be available by 1980, enabling the large increases in capacity from surface processing systems. In-situ retorting may also be advanced to the point where the first commercial operation could be initiated. By 1985 cumulative capacity is estimated at 1 million barrels per day from both private and public lands.

Production of about 138,000-198,000 barrels per day of shale oil would be needed by 1980 to replace the energy expected from the oil and gas from the East Texas sale. Since development is now only in the pilot plant stage, oil shale will not be available in significant quantities before 1980 due to the lead time required to scale up prototype technology to commercial operations.

Two major options are being considered for oil shale development : (1) mining followed by surface processing of the oil shale and shale-oil; and (2) in-situ (or in place) processing. Of the two options, only the mining-surface processing approach is believed to have been advanced to the point where it may be possible to scale-up to commercial production in this decade. In-situ processing is in the experimental phase and commercial application of this technique cannot be expected prior to 1980. The relative state of knowledge of the various operations required in oil shale processing is shown in Figure 7-1. 1/ It is apparent from Figure 7-1, however, that various technical approaches are available for each phase of the operations, and no single system is likely to dominate the initial development of oil shale.

1/ Most of the refining operations shown in Figure 7-1 would be performed outside of the oil shale region at refinery centers near markets for the products.

Until recent years, virtually all efforts to develop oil shale technology were directed toward mining, crushing, and above-ground retorting. Oil shale processing in this manner would require the handling of large amounts of materials. Figure 7-2 indicates the materials flow through such an operation, beginning with mining and ending with final fuel products and various by-products. In certain locations, the oil shale deposits contain minerals that may be amenable to recovery of additional by-products such as soda ash and alumina.

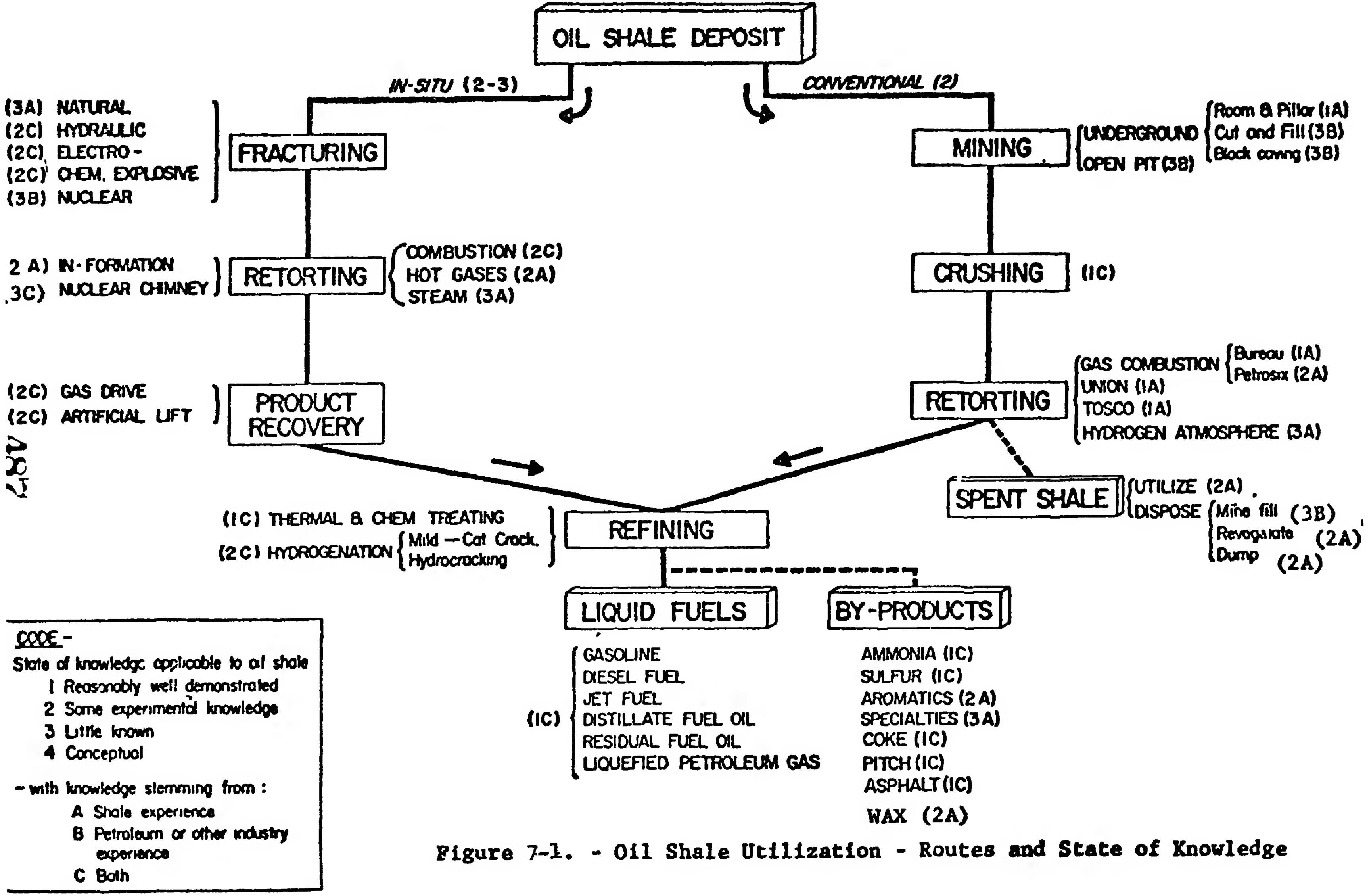

Figure 7-1. - Oil Shale Utilization - Routes and State of Knowledge

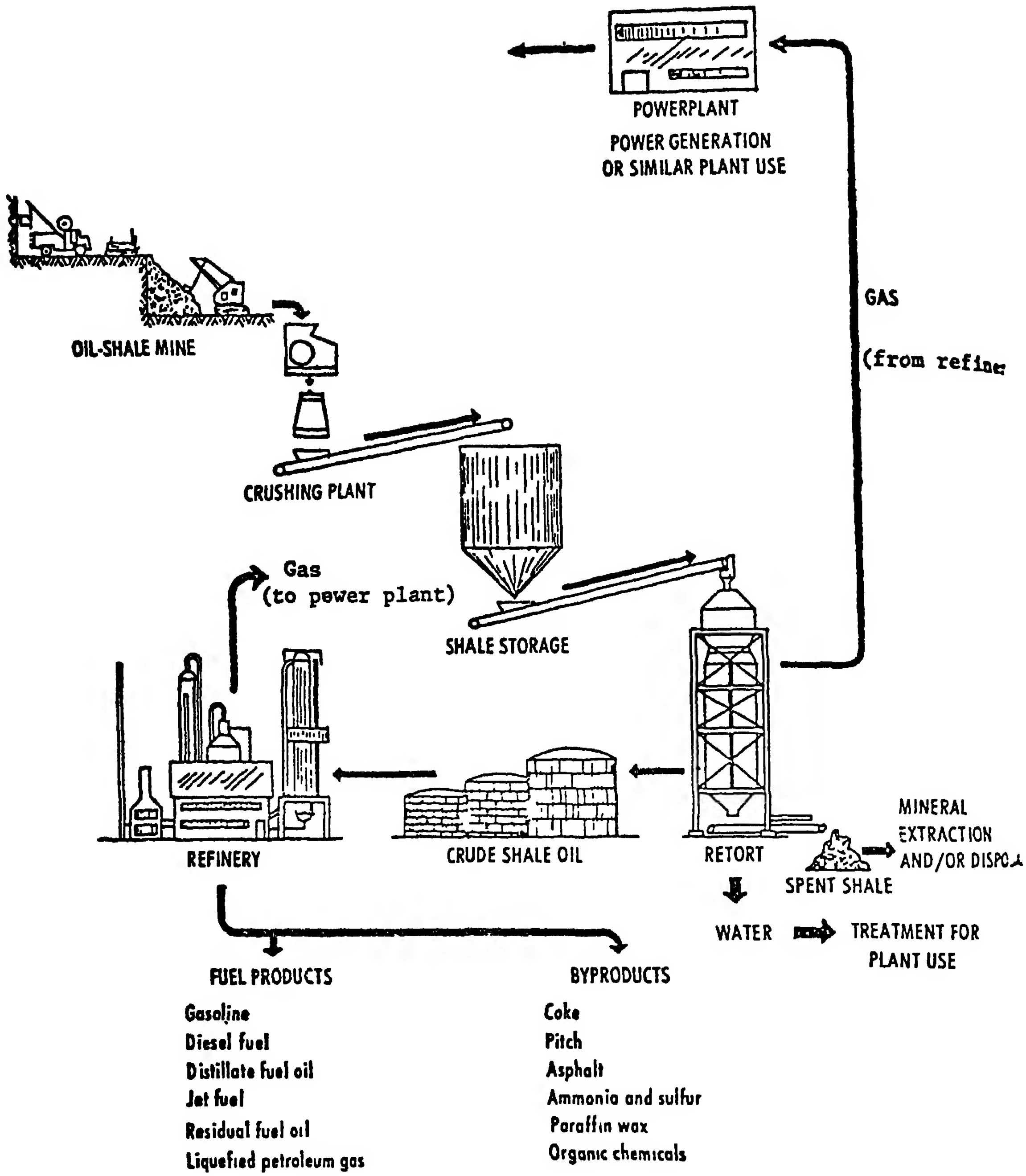

Figure 7-2.-Schematic Diagram of Oil Shale Surface Processing

Oil shale mining can be conducted either at the surface or underground. The former, usually described as open-pit mining, involves removal and disposal of the surface material or overburden before the oil shale can be mined. The quantity of overburden significantly affects the development time and economics. Current open-pit techniques and existing large-scale equipment are expected to enable mine development at relatively low costs, although disposal - restoration costs will be greater than similar costs for underground operations.

The room-and-pillar method has been extensively tested for underground mining of oil shale. In this development plan the recovery rate would depend on the depth and local conditions. In general, about 60% of the shale can be removed. The remainder is left as pillars for mine support and to prevent surface subsidence. It is expected, however, that some mining operations would provide substantially lower total extraction percentages. Room-and-pillar mining is characterized by large rooms over 60 feet in height, separated by the support pillars. Access to the oil shale to be mined can be gained from the surface either by a vertical shaft, or a horizontal adit or tunnel.

Crushing and conveying systems are technically and economically well-established and are regarded as necessary parts of any integrated processing system. The selection of specific equipment is primarily based on the size of the oil shale fragments needed for subsequent processing.

Literally thousands of retorting processes have been patented worldwide for the production of oil from oil shale. Three processes that have been tested using large experimental equipment appear at this time to offer reasonable possibilities of technical and economic success if scaled up to commercial design size. These retorting methods include the Gas-Combustion process developed by the Bureau of Mines, the Oil Shale Corporation (TOSCO) process, and the Union Oil Company process. In each system, heat is applied to raise the temperature of the oil shale to about 900 degrees F., where the solid organic material (kerogen) is converted to a liquid. The equipment, method of heat application, and operating procedures differ markedly for each system.

Oils from the retorting processes, with the possible exception of the TOSCO process, will require upgrading before the oil can be transported through pipelines to the final product refineries, which are expected to be located outside of the oil shale region. Modern refinery processes are suitable for subsequent upgrading. Each of the three retorts also produces a retort gas that may be used within the plant as a fuel, or alternatively, to generate supplemental electrical power for nearby communities.

Spent shale may be in the form of solid particles ranging from 10 inches in diameter to a fine powder, depending on the retorting

method used. It will normally be dry, but it may be wet if it is processed to recover saline minerals. Disposal will therefore depend on the physical characteristics of the material, its water content, and the location of the disposal area, whether surface or subsurface. If it is to be returned to the mine, this will affect the mine development plans.

Various processes for recovery of the saline minerals associated with the oil shales have been proposed.

The economical recovery of alumina, soda ash, and nahcolite (potentially valuable for removal of sulphur oxides from stack gases) from the deep oil shales has not yet been demonstrated on a large scale nor have the effects of their recovery been tested by current markets for these chemicals.

An alternate mining and processing technique would involve the recovery of oil from the shale by heating underground, in place. This technique is called in-situ processing and has not been successfully developed or demonstrated on a large scale, although considerable laboratory and field research has been carried out by government and industry.

Presently proposed heat sources for in-situ recovery include underground combustion, hot natural gas, hot carbon dioxide, superheated steam, hot solvents, and combinations of two or more of these. It

is anticipated that conduits for introducing heat underground would be provided by wells, mine shafts and tunnels, fractures created by a variety of techniques, or by a combination of these.

A commercial in-situ processing system has not been demonstrated to date, nor are there any indications that this is a viable technical option in this decade.

c. Environmental Impact

Oil shale development would produce both direct and indirect changes in the environment of the oil shale region in each of the three states where commercial quantities of oil shale resources exist. Many of the environmental changes would be of local significance while others would be of an expanding nature and have cumulative impact. These major regional changes would conflict with other physical resources and uses of the land and water. Impacts would include those on the land itself, the water and air quality, on fish and wildlife habitat, on grazing and agricultural activities, on recreation and aesthetic values, and on the existing social and economic patterns as well as other impacts. Increased urbanization of a region which is primarily rural would be an unavoidable consequence of oil shale development.

The development of an oil shale industry will require roads, mining, plant sites, waste disposal areas, utility and pipeline corridors, and associated services during the productive life of a lease. These activities will change the existing pattern of land use and alter the existing topography.

Development will unavoidably destroy the existing vegetation in the area of development. For a 200,000 barrel per day industry, some 10,000 acres total will be directly involved with the actual operations; an additional 2,000 acres will be required for utility corridors, and 4,000 acres will be required for urban expansion. The impact of development will be significant in local areas, but small for the region which encompasses an area of about 17 million acres.

Canyons may be filled to a depth of 250 feet and each may encompass an area of about 200 acres. Each canyon would, therefore, be permanently altered in appearance and as a faunal habitat. This would destroy habitat for threatened species as the spotted bat. If colonies of burrowing rodents are destroyed, any black-footed ferrets in the area will be displaced and probably destroyed. Reduced water quality or impoundments in waters inhabited by the Colorado squawfish, Colorado River cutthroat trout, honey-tail chub, and hump-backed sucker will result in further population declines for these species. Habitat subject to noise and disturbance will be lost to peregrine and prairie falcons.

Mule deer and antelope herds will be reduced by displacement and competition as habitat is destroyed. Animals such as the elk and mountain lion, which are less tolerant of human activity, will be denied a greater amount of habitat because of avoidance of noise and human activity. This will lead to proportionately greater reductions in numbers of these species. Hunting pressure and harvest will increase.

Loss of habitat, reduced water supply, and increased hunting pressure (including casual plinking) will reduce populations of sage grouse, hawks, eagles, bobcats, raccoons, etc., forcing displacement and increased competition for remaining food and water. Reductions in small prey species such as rodents and rabbits will also cause reductions in populations of predators.

Drying of streams, degrading of water quality, and any impoundments created will cause reductions or changes in desirability of fish populations. Species especially vulnerable to changes in physical conditions or water quality (temperature, pH, toxic substances) include trout and whitefish as well as the threatened species mentioned above.

Re-establishment of browse may be employed to encourage future wildlife development; however, land-use planning may indicate that the land should be restored for agricultural use, including grazing. At any one time, some 4,000 acres would not be available for any use such as grazing. Thus, oil shale development will unavoidably reduce the grazing capacity by about 34 animal unit months for each year of operation. Utility corridors are unavailable only temporarily after revegetation; forage production is normally equal or better than before. However, changes in lifestyles or other factors could lead some present livestock operators to reduce ranching activities or cease entirely which would reduce utilization and production of beef.

New roads, plant sites, waste disposal areas, and utility corridors which would be part of oil shale development would unavoidably affect the appearance of the present landscape and may be considered adverse. The general area was formerly inhabited by nomadic, hunting, Indian tribes. Any disturbance of the surface would possibly disturb unknown historic archeological sites or artifacts.

Oil shale development will stimulate water needs not only in the form of process requirements, but also in a secondary sense as communities develop to support the oil shale industry. The most likely demand for water ranges from 24,000 to 38,000 acre-feet per year to support both processing and urban requirements. Even with tight controls to avoid or minimize water contamination, industrialization would result in a decline in water quality. Salinity changes will be slight since it is estimated that a 200,000 barrel per day shale oil industry could increase the salinity concentration of the Colorado River at Hoover Dam by only 0.3 percent.

Extremely poor quality ground water or water from the various process streams may either have to be treated and/or disposed of beneath the ground. The discharge and recharge of ground waters could result in a net reduction in the long-term unavoidable adverse effect of some subsurface aquifers through lower aquifer pressure and water levels, thereby decreasing the flow of springs presently used for irrigation and stock watering. In addition, saline water may move into aquifers that now are fresh, reducing the future quality of ground water available for human and agricultural use. This latter condition may not be realized for some time since underground percolation of streams and resulting water migration could take years for the subsurface pressures to be redistributed.

Since the air in the oil shale regions is essentially free of pollutants today, industrialization will unavoidably adversely affect localized areas. Emissions added to existing conditions would include particulates, sulfur dioxide-hydrogen sulfide, nitrogen oxides, and carbon monoxide. In the short-term, there is not expected to be significant harmful effect to either humans, animals, or plants. However, the long-term productivity in highly localized areas could be reduced because of the additive effect upon plants, animals, and humans. Although ambient air quality standards are attained, the long-term effect of industrialization will result in a decline in general air quality of the region.

8. Wellbore Stimulation for Recovery from Known Deposits

a. Description of the Alternative

Formation "acidizing" and "fracturing" methods are commonly applied in oil and gas wells to stimulate recovery from tight formations and mature fields. Because such wellbore stimulation methods, as conventionally applied, have become an accepted part of producing practices, they cannot be regarded as offering an alternative way of achieving new production. For example, in 1971 Louisiana produced 766,079,742 barrels of crude and condensate, of which 217,324,447 barrels (or 28.4 percent) was from secondary recovery projects. There are presently 925 active projects in 177 fields. This includes 85 new projects initiated in 1971, of which 55 were gas injection, 29 waterflood, and 1 gas and water injection. 1/

One innovative method, nuclear stimulation, does have the potential to add materially to the nation's recoverable gas reserves. This method would use nuclear explosives to fracture low permeability gas reservoirs otherwise incapable of sustaining commercial flow rates.

Current emphasis in the U. S. Atomic Energy Commission's Plowshare program is to develop the technology for applying the effects of

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1/ Testimony presented at the public hearings for the proposed East Texas Sale, Houston, Texas, February 21, 1973, by Ray T. Sutton, Commissioner of Conservation of the State of Louisiana.

nuclear explosions to the recovery and utilization of natural resources, primarily natural gas. The program plan is to continue the design and testing of the nuclear explosive, and to assess by field tests techniques for utilizing the effects of multiple nuclear explosives to recover natural gas locked in tight geological formations Such gas cannot now be economically produced by conventional methods. Most reserves lie in thick, deep reservoirs of very low natural permeability, geographically situated in the Rocky Mountain Belt.

Projects Gasbuggy and Rulison are essentially pilot experiments involving the detonation of a single nuclear explosive. Both of these projects are clearly demonstrating that recovery of natural gas by nuclear explosion stimulation is technically feasible and economically promising. The next development phase involves techniques for using multiple explosives in single wellbore. Gas formations amenable to nuclear explosion stimulation are thicker than can be effectively and feasibly stimulated by a single explosion.

The Atomic Energy Commission has recently reported on the possible scope of nuclear stimulation, and has provided an economic assessment of the technical programs needed to achieve commercially

viable application of nuclear stimulation of natural gas wells. The AEC concluded that, based on certain assumptions, "over 10 percent of the Nation's current gas consumption could be met by gas fron nuclear stimulation by a development rate of about 50 wells per year". The report indicates, however, that it would take approximately 20 years before gas produced from stimulated reservoirs would be about equal to 10 percent of 1969 consumption. To accomplish this level of production it would be necessary to explode 4,000 nuclear devices of 100-kilotons each in 1,000 wells over the 20 years.

Most natural gas resources amenable to nuclear stimulation are located in the Rocky Mountain region where approximately 300 trillion cubic feet of gas is estimated to be potentially recoverable using modern technology.

The current development program rate is not expected to provide, in the next ten years, quantities of natural gas that would be meaningful in comparison with present sources of supply.

b. Incremental Production

Assuming successful development of the technology, the AEC estimates that nuclear stimulation could add some 1 trillion or more cubic feet of natural gas to U. S. production per year

beginning in the late 1970's, increasing to 2 trillion by the late 1980's, and to about 3 trillion cubic feet by the 1990's.

c. Technological Feasibility of Substitution

To the extent that natural gas could displace crude oil demand, this method might be considered a partial alternative to OCS development. It is not now considered a practical alternative because the commercial technology remains to be developed. Several years of development work need to be carried out before the nuclear stimulation technology will be available for commercial applications.

d. Environmental Impact

The AEC's Plowshare program to increase natural gas production from tight reservoirs could conceivably affect the environment in two ways. First would be the effects of radioactivity. Secondly, seismic disturbances would have adverse effects. However, atmospheric contamination or disturbance is unlikely.

Most radioactivity produced by the explosives will remain underground trapped in the resolidified rock near the bottom of the chimney or attached to the rock surfaces in the chimney. Project chimneys remain isolated from them. The formations of interest

for nuclear - explosive stimulations are generally at depths of 5,000 to 10,000 feet or deeper, have low permeability, and would not be expected to contain mobile water. Significiant vertical communication with shallow water-bearing formations through existing or created faults or fractures could present a serious limitation. Water produced with the gas from nuclear - explosive stimulated wells will contain tritium. Control methods to dispose of this contaminant will have to be developed.

The chemical composition of the gas itself in each stimulated well is assumed to be similar to that measured in the first experiments. The intitially large carbon dioxide concentration in the chimney would be reduced by dilution with pipeline gas or carbon dioxide would be removed by standard gas field practices. Gas production from the wells could be delayed until short-lived radionuclides decayed. Technical information from subsequent experiments will aid in defining the time for initiation of production.

The remaining gaseous isotopes--tritium and krypton-85--are calculated to provide less than one millirem per year of exposure to the general population if the gas were used as a part of the total gas supply to a large city. No insurmountable problem is anticipated

in meeting future regulations or standards developed for sale of the gas. It should be emphasized that the environmental impact of using gas that contains small amounts of tritium will have to be weighed against not having the gas available to augment the Nation's energy sources.

The potential environmental impacts resulting from nuclear stimulation of a single well or in a small geographic area have been stated and evaluated in the environmental impact statements prepared for the proposed Phase I Rio Blanco 1/ and Wagon Wheel 2/ projects. Extrapolation of the impact to a full commercial development is related primarily to the frequency and size of explosives and to changes in local environment as the areas of development expand.

A schedule that has been analyzed calls for drilling and firing 100 wells per year (for possibly 50 to 60 years). On the average this would involve approximately 370 explosive devices per year; usually 3 or 4 explosives in each well. Spread uniformly over the year, simultaneous firing of the multiple explosive loads could result in

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1/ Environmental Statement--Rio Blanco Gas Stimulations Project, U. S. Atomic Energy Commission, Washington, D. C., Dept. Wash. - 1519 (April 1972).

2/ Environmental Statement--Wagon Wheel Gas Stimulation Project, U. S. Atomic Energy Commission, Washington, D. C., Dept. Wash. - 1524 (April 1972).

local area disturbances as often as every nine days. This would have a substantial impact on wildlife and public residents and visitors. The seismic nuisance could be lessened by preparing several wells to be shot on the same day. Four detonation days per year should suffice for the 30 to 40 wells to be completed for each field area.

The size of the explosive required to stimulate the very thick geologic sections and the actual seismic effect of such devices are still subject to some uncertainty. Prior to full field development, this impact must be assessed and evaluated for the specific situation and locality. Public inconvenience and repairable or negotiable damage must be compensated. Irrepairable or non-negotiable impacts would deter development.

In extrapolating the projected or observed impact of test projects, consideration must be given to the total environment of the basin. The site for the Rio Blanco experiment, for example, is relatively isolated. There are thought to be no surface or subsurface structures or operations in the zone of substantial damage. The fact that this will not invariably be true is an important environmental consideration when planning commercial development.

By its nature, nuclear stimulation has a dramatically destructive effect on the natural-gas host rock. The fracture zone should extend 300 to 400 feet from the center of the explosion. Also the compression wave moving out from the explosion can cause spall near a free surface (ground level) or other faulting or fracturing in areas where there are relatively large directional stress concentrations. This leads to concern where there are other valuable mineral resources in the vicinity. There is an unusual complexity in discussing the potential effect on other mineral resources from nuclear stimulation of the natural-gas basins as an energy alternative since oil shale and associated sodium and aluminum-bearing minerals also represent major mineral resources in the basins which are known to exist for potential development.

Surface impact of nuclear stimulations on vegetation will largely result from road building to well sites, and from clearing of drill site areas for drilling and production operations. Drill site locations will return to natural conditions in a short period. This would be similar to conventional gas well drilling and production. The areas affected by natural gas stimulation will be quite small and no significant impact on productive use will occur.

The need for local services and materials will have relatively little affect during the first experiments, but as the field development program advances, the need will become greater. Long-

term employment associated with full field development could involve hundreds of direct gas industry employees. Current local sources of supplies and services would have to be substantially increased or supplemented. Since much of the work would be conducted year-round, undoubtedly there would be families moving to the areas, causing an increase in such community needs as schools and homes. Additional revenue would be forthcoming to the counties, as well as to the State and Federal Governments.

The development of nuclear stimulation of natural gas reservoirs may be accompanied by some possible damage to existing structures, due to ground motion. Damages would have to be repaired, or compensation rendered to owners. Ground motion is predictable and utmost care would be used to minimize this effect.

It has been suggested that residual stress from a number of detonations might accumulate and present an earthquake stimulation hazard not present in a single detonation. The best evidence available on this point is from experience with the Nevada Test Site, where data from seismic wave generation and from stimulated fault motion indicate that the cumulative effect of many explosions is to reduce ambient stress levels rather than to increase them. A recent series of high-precision geodolite measurements indicates, also, that the residual strain field around a single explosion site tends to relax

with time. In any case, observations of the seismic effects of a series of detonations would permit continuing appraisal of this issue. In the light of present information, it does not appear to constitute an adverse environmental impact.

Adverse environmental impacts for nuclear gas stimulations on a commercial scale should be small in comparison to the benefits to be obtained. Both oil and gas will be needed in increasing quantities in the future. The proposed project is supplemental to other means of increasing natural gas supply. Some quantities of natural gas that would meet clean fuel requirements could be made available in the 1975-1980 time frame if nuclear gas stimulation technology is vigorously pursued. The public acceptance questions involved in proposals for nuclear stimulation of natural gas reservoirs exceed expected technical problems.

e. Health and Safety

The production testing technique for current experiments involving initial flaring of gases containing low levels of radioactivity is not contemplated for commercial production. All produced gas is expected to be fed into commercial pipelines.

The depth of the gas formations of interest throughout the Rocky Mountain area is such that the probability of releasing any radiation to the atmosphere at detonation time is very low. Even so, every reasonable precaution would be taken during the field development program to prevent even a slight accidental seepage of radioactive gas to the atmosphere. If an unforeseen seepage of radiation were to occur, previously developed remedial plans would be initiated. Although radiation would not be expected to be detected, long and short-term radiation monitoring techniques would be employed during field development.

9. Increase LNG Imports

a. Description of the Alternative

Because of the more than 600:1 volume reduction which occurs when natural gas is liquefied, large volumes of natural gas in a liquefied form are relatively easier to transport and to store. Though natural gas has been liquefied 1/ commercially since 1940, in the United States its use until recently has been on a small scale, primarily by gas utility companies for peak-shaving purposes.

Because of the growing shortage of domestic gas supplies, plans are now being made by the gas industry for large liquefied natural gas imports under long-term contracts. Recently the FPC approved two projects which together call for deliveries of more than 1 billion cubic feet/day of LNG from Algeria. Algeria is currently providing baseload quantities of LNG to England and France.

The following table is derived from FPC staff's projections of LNG imports to 1980 2/. Those projections were based on the assumption that all the projects which have been filed with the FPC, as well as those which were currently being discussed by industry, would be in full operation by 1980.

1/ Natural gas becomes a liquid at -259 degrees F at atmospheric pressure.

2/ Federal Power Commission, Bureau of Natural Gas, "National Gas Supply and Demand 1971-1990, Staff Report #2, p. 70.

LNG Imports

Year	Quantity MMCF/Day
1975	800
1976	1,900
1977	2,700
1978	3,600
1979	4,700
1980	5,500

While foreign supplies of natural gas appear to be adequate to meet these requirements, it should be noted that much of U. S. imports of LNG will be from areas where political instability could impair the security of supplies. As with crude oil imports, increasing LNG imports could also have an unfavorable impact on balance of payments.

b. Incremental Production

If the proposed OCS sale is withdrawn and the expected production replaced by LNG, imports would have to increase in the range of 778 to 1,112 million cubic feet/day. This figure represents the expected gas production of 750 to 1,050 million cu. ft./ day, plus 28 to 62 million cu. ft./day to substitute for the expected oil production. An increase in imports of this amount would require one additional LNG tanker receipt each 2 to 3 days. Thus by 1979, when

production from this sale should be on-stream, LNG imports will have to increase above the projected levels by 17% to 24%.

LNG imports to substitute for this sale would require an increase in either the size or number of regasification plants now being proposed and in the number of LNG tankers. Since an LNG project requires a lead time of about six years, planning should begin at the same time that the sale would have been held.

Estimating the cost of this increase in LNG imports is difficult at this point in the development of the program. One way to arrive at an idea of the costs is to look at two projects recently approved by the FPC. A plant at Cove Point, Maryland, with the ability to produce 650 million cu. ft./day will require an initial investment of about 93 million dollars. An additional 89 million dollars will be required for the construction of pipeline. 1/ Another approved project will bring about 350 million cu. ft./day into Savannah, Georgia, and will require 63 million dollars for the plant facilities. This project also calls for 25 million dollars for pipelines. At full operation these two plants will import the equivalent of one billion cu. ft./day. The cost of the Alergian facilities will be about $675 million. Although this cost is not currently borne by American companies, it becomes important in future projects. The companies involved have estimated that this level of imports would mean an

1/ All data taken from Federal Power Commission Docket No. CP 71-68.

investment of about 750 million dollars for LNG tankers. The increase in imports presented in this alternative would be close to the projected size of these projects. Further applications filed with the FPC indicate the costs in the Cove Point and Savannah projects may be significantly lower than for future projects. It would appear that if this alternative were selected to replace the sale, it could entail an investment of more than one billion dollars in plant and tanker facilities.

The price to the consumer of imported LNG is also difficult to project. The FPC, in approving the El Paso Natural Gas Co. application to import LNG, limited initial prices to 77¢ per million BTU's delivered to Cove Point, Md. and 83¢ at Savannah, Ga. The company has indicated that the allowed prices may be insufficient. Even if allowed LNG prices are not increased, LNG will be more costly in East Coast markets than the new gas expected from the proposed OCS sale. The current ceiling price for new gas in the offshore Louisiana area, under the area rate method, is 26¢/Mcf. Under the FPC's new optional pricing system the price of OCS gas could rise. The first applications under this policy have proposed to sell gas for 45¢/Mcf.

c. Technological Feasibility of Substitution

Increasing LNG imports to substitute for this sale would be technologically feasible. LNG processes are well developed.

LNG is regasified and distributed in regular natural gas pipeline systems.

d. Environmental Impact

One beneficial effect of this alternative would be the substitition of clean natural gas for oil. The quantity of oil however that would be replaced by LNG if the lease sale were not held would be extremely small when compared to the total projected domestic consumption of oil. It is doubtful, therefore, that this substitution will have a significant effect on the atmosphere. In the regasification of the LNG, gas or water will provide the heat for vaporizing the LNG and the release of significant pollutants into the air is not expected.

The construction of regasification plants will have an impact on land resources. The extent and duration of the impact will depend on the size and location of the plant. While there will be some disruption of the land surrounding the plant during construction, this disruption should be temporary if proper techniques are used. During construction there will be some damage to animal habitats. This damage will be permanent only in the area occupied by the plant and supporting facilities. Surrounding areas that may be damaged should return to a near-normal condition after construction is completed.

Existing pipelines will be used to transport regasified LNG, if they are available, but new pipelines will be required in some areas. The potential environmental impact due to pipeline construction is examined in the section of this statement dealing with the effect of increasing onshore U. S. gas production.

Each regasification plant will require facilities to permit the transfer of LNG from tankers to storage areas. In the Cove Point case, this will be accomplished by the construction of a mile-long pipeline into the Chesapeake Bay. At the proposed Savannah plant a channel and a turning basin would be dredged in the Savannah River to allow the tankers to come close to the plant. Both of these methods will require initial dredging, and possibly continued dredging, causing increased turbidity of the water and disruption of marine animals, especially in the case of bottom-dwelling organisms. In most cases this disruption would be temporary, but care would have to be taken to avoid, as much as possible, commercial fishing areas.

Since natural gas or water will be used to regasify the LNG, very few pollutants will be released into the nearby body of water. Plants using water to regasify the LNG will release the water at a lowered temperature. In the case of the Savannah plant, water temperature will be lowered $5^{o}F$ in the vaporizor and then will be returned to

the river. This lower water temperature could be beneficial by allowing the water to hold more oxygen. The amount used and released, however, will be very small in comparison to total volume of water passing the plant.

A regasification plant could have an impact on the scenic and recreational resources of an area. The choice of the plant site is an important factor in minimizing the impact on scenic qualities and recreational activities. The increase in ship traffic could have an affect on water-oriented recreational activities.

e. Health and Safety

A major concern of any regasification project will be to insure that proper precautions are taken during the handling and storage of the LNG. An early LNG plant was destroyed by a disastrous fire in 1944 due to the failure of a storage tank, with a loss of more than one hundred lives. Many improvements have since been made in the technology of storage and handling of the LNG and increased attention has been given to proper safety precautions. The recent explosion of a Staten Island storage tank, resulting in the death of more than 40 men, shows that there is still, however, an element of danger involved in the storing and handling of LNG.

Studies on the possibilities of explosions resulting from LNG spills are inconclusive. Bureau of Mines tests indicate that under certain conditions small-scale explosions result when the LNG is poured onto

water. They are not able, however, to predict the result of a large-scale spill on open-water. Another study, by Shell Pipe Line Corporation, concluded that there was little danger of normal LNG exploding when spilled on water. They feel a vapor explosion could result only after the methane content of the LNG had reached 40%. Since the normal methane content of LNG is 80-90% or more and the boil-off rate is 0.2%-0.3% per day, it felt that with present day shipping practices a reduction to 40% is not possible. 1/ Worldwide experience to date in the handling and shipping of LNG has resulted in no serious explosion or fire. Since 1961, when commercial delivery of LNG by tanker began, there have not been any accidents at sea. However, there have been LNG spills reported in certain foreign countries but they have not been serious. Further discussions with the Bureau of Mines have indicated that an explosion resulting from an LNG spill in open water is unlikely.

Another hazard associated with LNG is the possibility of a major fire resulting from spillage or leakage in transportation, transfer and storage. Since spilled LNG would not vaporize instantaneously, the release of the equivalent of several million cubic feet of gas, for

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1/ Tholief Enger, "Rapid Phase Transformation During LNG Spillage on Water", paper presented before The Third Intermation Conference and Exhibition on Liquefied Natural Gas, September 1972.

example, might cause a fire which would continue until all the LNG had vaporized. The Bureau of Mines also reports that, if there were no fire, the concentration of natural gas in the area of the spill and downwind from the spill would be significantly higher than normal. Both of these factors could become significant if a major spill occurred near a heavily populated area.

10. Synthetic Natural Gas and Oil

a. Description of the Alternative

Through hydrogenation processes, it is possible to convert coal to various hydrocarbon liquid and gaseous substitutes for natural oil and gas. Considerable research and development has been done and further R & D is being conducted by the Federal Government and private industry. While many individual units for commercial gas processes have been tested, synthetic gas has not yet been proved economical in the United States. There are presently no coal-to-liquid conversion plants in the United States. The Department of the Interior's 1972 coal research report (USDI, Office of Coal Research, 1972), describes much of the work currently in progress.

The President, in his Clean Energy Message of June 4, 1971, and in subsequent messages, has given special attention to accelerating development of coal gasification.

The feasibility of producing synthetic natural gas and oil from coal as an alternative to the proposed lease sale depends upon the rates at which technological systems are developed, tested and proved economic and at which commercial scale plants are built. While it is possible that substantial amounts of synthetic fuels could be produced from coal by 1980-1985, the state of technology permits no accurate forecast.

Natural gas can also be synthesized from petroleum. Such gas has been produced commercially in Europe and some 25 plants are in the planning stage for the United States. While the gasification of oil does not add to overall energy supplies, it does provide an additional flexibility in energy form.

b. Coal Gasification

The need for natural gas has been discussed in the section relating to Federal Power Commission natural gas pricing policies. Because of its clean-burning characteristics, gas is the preferred fuel for use in small installations-such as for home heating--where economics preclude the installation of pollution control equipment.

In the event of limited gas supplies, steam-electric power plants will probably be the first to be denied the use of pipeline-quality gas. Coal can be converted to a clean, low-Btu gas for use under utility boilers. Although such synthetic gas can be piped short distances, it will be more economical to use it adjacent to the gasification plant.

While no coal to pipeline-gas process has yet reached commercial application in the United States, at least two companies plan to construct a commercial coal-gasification plant using the Lurgi process, which has been known for a number of years, and has been applied commercially in Europe. The earliest date for production from these

projects is 1976. Since gas produced by the Lurgi process has heating value of only 400-450Btu/cf, catalytic methanation is required to achieve pipeline quality of 1000 Btu/cf for American gas utility use. This step has not yet been commercially demonstrated.

The Department of the Interior and the American Gas Association are cooperating on the accelerated program for coal gasification announced by President Nixon in his Clean Energy Message of June 4, 1971. Two coal gasification pilot plants have been built and are now undergoing shakedown operation, and a third plant has been authorized. In each of the plants a unique gasification method will be tried in conjunction with different systems of gas cleanup and methanation so that a final process, combining the best features of the individual processes, can be chosen by the summer of 1975. Construction of a demonstration plant is expected to follow so that a large-scale plant will be on stream by 1977.

Research over a period of fifteen years by the Bureau of Mines has culminated in the development of the "Synthane" process. In June 1971, a contract was let to Lummus for design of a pilot plant.
A draft environmental statement (DES 72-3) was released January 24, 1972.
Meanwhile, a smaller pilot plant will be operated by Hydrocarbon Research, Inc., under a contract with the Bureau. The Bureau also

has under review another coal gasification scheme, termed a modified Lurgi process, to use strongly caking coals for making a clean, low-Btu gas.

It will require about 5 million tons of coal a year to support one 250 billion Btu per day coal gasification plant (minimum commercial size). When full production is reached, the oil and natural gas expected from this sale should provide 803 billion to 1150 billion Btu's/day. Thus complete substitution by coal gasification would require 3-5 plants of the 250 billion Btu's per day size. This number of plants would require 15-25 million tons of coal per year and 3 to 5 mines. Estimates for the cost of a plant to process 250 billion Btu's/day are about $250 million including the coal mine. Recent estimates by the Office of Coal Research, and the Bureau of Mines, using utility type economics, project a selling price for the gas of about 85-95 cents per MM Btu at the plant. Revisions of these figures can be expected as pilot plant projects are evaluated and technology developed.

c. Oil Gasification

Synthetic natural gas (SNG) can also be produced from petroleum feedstocks. Processes that are being considered include:

1. Thermal cracking in steam.
2. Thermal cracking in a hydrogen-rich atmosphere.
3. Catalytic cracking in steam.
4. Partial oxidation.

Currently, much attention is being given to catalytic rich processes, developed by the British Gas Council. Called the CRG (Catalytic Rich Gas) process, it can gasify a wide variety of hydrocarbon feedstocks, though attention now is concentrated on naphtha feedstocks.

A CRG plant involves two basic operations:

1. Feed preparation, including fractionation and desulphurization.
2. The CRG process, per se, including gasification, and methanation to a gas with a heating value of 980 Btu per cubic foot.

Desulphurization of the feedstock is accomplished by mixing the feed with hydrogen-rich gas, vaporization, and treatment with nickel-molybdate and zinc oxide catalyst. If sulphur is to be recovered, the sulphur-rich fraction is hydrodesulphurized.

About 25 SNG projects, using naphtha feedstocks, have been announced. About half of these state that they intend to operate on imported naphtha. Estimated costs for SNG range from $1.25 to $1.75 per MM Btu.

The environmental impacts of such plants are expected to be less than those of comparable coal-based synthesis plants, because they would be free of ash and char, and sulphur oxides and particulates discharge problems.

d. Coal Liquefaction

Until recently, there has not been the same sense of urgency with reference to the conversion of coal to clean-burning oil as exists for pipeline gas. One reason is that imported oil has been available at cheaper prices than a synthetic crude. Also, environmental restraints have forced some electric utilities to abandon the use of coal, or to forego its use in new plants. The supply of low-sulphur coal in the East is limited, additional natural gas for electric utility use is not now available to householders and commercial users, electric utilities may soon be restricted or banned from using natural gas.

Accordingly, the supply problem relating to oil now is being viewed in a more urgent context. The situation, however, as regards the necessity for developing coal-to-oil technology is not yet escalated to an urgent program basis.

The Department of the Interior has filed a Final Environmental Statement, and will soon erect at Fort Lewis, Washington, a Solvent-Refined (SRC) pilot plant. Consideration is now being given to the conversion of Project Gasoline and the pilot plant at Cresap, West Virginia, to test a simplified version of the H-Coal process, and a Bureau of Mines coal conversion process along with others.

Because coal-to-gas, oil-to-gas, and coal-to-liquid fuel plants would be similar in most respects (boilers, reactors, gas scrubbers, etc.) the environmental impacts would be similar. The impacts of transporting these products to market via pipeline has been discussed in an earlier section. The environmental impacts of coal mining have also been discussed and will not be repeated here.

e. Potential Environmental Impact of the Alternatives

Like natural gas, synthetic (also called substitute) natural gas and oil from coal are clean-burning fuels because the sulphur has been reduced to very low values, and no particulate natter is emitted at the point of combustion.

Since there are ample reserves of coal in this country, conversion plants would afford a reliable supply of synthetic fuels for many years, thereby reducing dependence on imported oil and LNG, and concomitantly lessening the potential adverse environmental effect associated with shipping these fuels and delivering them in ports.

wing to the fact that this report is general, and does not bear on particular site in the United States, the importance and magnitude f the possible environmental impacts must be estimated. Obviously, he impacts will vary greatly with plant location.

n the basis of some limited pilot plant data, and knowledge of other ndustrial plants and complexes, some estimates can be made about the rincipal environmental impacts.

Site preparation and plant erection will have environmental effects, the kinds, importance, and magnitude of which will depend on the site that is selected. Consideration would be given to the effect on factors such as earth, water, flora, fauna, land use, recreation and aesthetics.

Plant operation, consisting of handling and transporting the coal to the process and converting the coal to gas and/or oil, will involve very large quantities of water for cooling and scrubbing gases, and very large quantities of devolatilized coal, called char, which will be burned in boilers to generate process steam and power, or gasified to make process hydrogen. Major emissions that must be controlled are:

1. Sulphur and nitrogen oxides, bottom ash and fly-ash from the plants generating process steam and power. Fly-ash emission from boiler stacks can be controlled, and furnace-bottom ash and slag are handled routinely without environmental problems. However, it may become desirable to locate large coal-conversion plants near large strip mines, where ash and slag from the process would be returned to the open cuts, and the ground restored in accordance with environmental considerations. The technology for controlling sulphur and nitrogen oxides from such plants will be available when the processes become commercial.

2. Contaminated water discharges containing phenols, cresols, benzene, oils, tars; and ammonia gaseous discharges from the Claus tail gas containing some hydrogen sulphide dioxide; and solid discharges such as char and ash; and possibly solids from gas-scrubbing systems using solid sorbents such as dolomite. Process waste waters can be scrubbed free of sulphur compounds. Waste solids such as spent dolomite may present disposal problems in terms of available space and/or surface water contamination, but these are not insurmountable problems.

3. Noise will occur from mechanical equipment, injectors, and pressure-reduction devices, but it is unlikely that it would be a problem beyond the plant property lines.

To illustrate the order of magnitude of the major emissions that would have to be handled from a commercial coal-to-pipeline gas plant, the FPC's National Gas Survey gave the following estimates, based on a plant producing 250 million standard cubic feet per day of pipeline gas 1/ from coal with 3.7 percent sulphur:

	tons per day
Sulphur (mainly as hydrogen sulphide)	300-400
Ammonia	100-150
Phenols	10-70
Benzene	50-30

1/ This size SNG plant produces the equivalent of 40,000 bbls per day of crude petroleum.

	tons per day
Oil and Tars	trace to 400
Ash (based on coal with 10% ash)	1500

The Federal Power Commission report describes in detail the general means for controlling contaminants in the process waste waters, and the various gas steams.

11. Energy Conservation

If demand for energy could be reduced sufficiently, the projected oil and gas production from the proposed lease sale would be unnecessary. However, it is a misleading simplification to view the choices as either (1) producing 5-11 thousand barrels of oil and 750-1050 million cubic feet of gas per day from the OCS leases or (2) reducing demand for energy by this amount. Several considerations invalidate this seemingly logical reasoning: the widening gap between demand and supply of energy from all sources in the near future, the immediate shortage of natural gas, and the limitations from the point of view of technology, cost, and time lag on substitution of other energy sources for oil and gas.

The shortage of natural gas is already evident. FPC estimates that demand for natural gas will exceed supply from all sources (including LNG, coal gas, and pipeline imports) by 3.6 trillion cubic feet in 1975, 9.5 trillion cubic feet in 1980, and 13.7 trillion cubic feet in 1985. The projected production from the lease sale of 750-1050 million cubic feet/day, or 274-383 billion cubic feet a year, is equivalent to only 3.8% to 6.9% of estimated 1980 unsatisfied demand. Thus, only by reducing demand for natural gas by an amount greatly exceeding the projected lease production would such production be unnecessary.

The demand for energy in the U. S. has been increasing at an average rate of 3.1% annually for the last twenty years, more than twice the growth rate of U. S. population. The United States has both the highest per capita consumption of energy and the highest per capita income in the world. Standard of living and GNP have been correlated to energy consumption. Continued increases in material standard of living tend to be equated with increased number, variety, and size of objects which consume energy in their construction and operation: automobiles, aircraft, refrigerators, air conditioners and the like. In the past, energy growth has been little constrained by price or by supply of resources. However, uncertainty of long-term energy supplies, recognition that environmental costs should be reflected in the price of energy, and concern over environmental quality will affect future energy use.

One approach to reduction in growth of energy demand is reduction in population growth. The association between rapid population growth and rapid economic expansion is no longer valid. The Commission on Population Growth and the American Future states: "We have looked for, and have not found any convincing economic argument for continued national population growth. The average person will be markedly better off in terms of traditional economic values if population growth follows the two-child projection rather than the three-child one." 1/ (Two children per woman approximates long-term Zero Population Growth fertility rate).

1/ Commission on Population Growth and the American Future, Population and the American Future, March, 1972.

U. S. population growth is in a transitional phase and appears to be declining. Population in 1970 was 204 million. Even if family size drops to a two-child average, population will continue to grow, reaching 271 million by 2000. The three-child family would bring the population to 322 million, or 51 million more than the two-child family over the next three decades. 1/

In the short term, reduction in population growth will do little to reduce growth in energy consumption. In a study of electricity demand, alternative population projections showed that "the population assumption is unimportant for demand growth in the next 20 to 30 years". 2/ In addition, the most important factor in growth of energy demand has not been population but higher energy use per capita.

The most promising approach to reduction in demand is therefore through lower per capita use of energy. The rate of growth of per capita energy demand could be reduced by (1) reducing the rate of growth of demand for the goods and services produced with energy, (2) producing the demanded goods and services more efficiently, and (3) converting energy to useful work more efficiently. Sectors with great potential for energy savings are residential space heating and cooling and transportation.

1/ Ibid.

2/ Duane Chapman, Timothy Tyrrel, Timothy Mount, Electricity Demand Growth: Implications for Research and Development, June, 1972.

Economics in energy consumption could be realized in space heating and cooling. Electrical power generation is only about 35% efficient and another 10% of generated power is lost in transmission. In contrast, oil fired home furnaces are about 65% to 85% efficient in generating heat. Better insulation could further reduce fuel consumption in homes. Solar heating and heat pumps for home heating require research and development but offer promising possibilities.

A step forward was taken in 1971 with the revision of the Federal Housing Authority's Minimum Property Standards (MPS) for single family dwellings. The MPS establishes thermal design criteria for qualification of residences for FHA-insured mortgages. However, new homes constructed through conventional financing are not required to follow these standards. A study of construction practices found that appreciable energy savings were possible through better insulation. The revised FHA-MPS do not distinquish between electrically heated and combustion heated homes. Consequently, the potential electricity saving afforded by the revised Standards is only 30% of the saving afforded by the economically optimum insulation in the southern region where electric heat is most popular and only 40% in the central region. Additional insulation would afford further energy savings. 1/

1/ John C. Moyers, The Value of Thermal Insulation in Residential Construction: Economics and the Conservation of Energy, Oak Ridge National Laboratory, December, 1971.

The National Wood Insulation Association also projects energy savings by thermal treatment of residences. Two approaches are examined: a "total participation" program and a "reasonably attainable" program. Without better thermal treatment, energy usage for residential space conditioning over the next ten years is estimated at 96,500 trillion Btu's. The reasonably attainable program would cut this amount by 8.5%, the total program by 15.9%.

The Office of Emergency Preparedness estimates that by 1980 space heating and cooling requirements could be reduced by 30% through improved insulation and a nationwide education program to encourage conservation practices in the home. 1/ Thermal insulation also reduces the energy required for air conditioning, an important factor in summer peak loads of utility systems. Different models of air conditioners vary greatly in efficiency. The least efficient consumes 2.6 times the electricity consumed by the most efficient to provide the same cooling. If more efficient air conditioners were used, the annual power consumption for air conditioning in 1970 could have been reduced by 15.8 billion Kwh, or about 40%. The connected load would have also been decreased by 40%, or by 17,800 MW. 2/

1/ The Potential for Energy Conservation, October 1972.

2/ Eric Hurst and John C. Moyers, Improving Efficiency of Energy Use: Transportation and Space Heating and Cooling, written testimony submitted to the House Subcommittee on Science, Research and Development, June, 1972.

Substantial reductions are also possible in the transportation sector. The transportation of people and goods comprised 24.5% of U. S. energy consumption in 1970. In 1970 motor vehicles consumed more than 40% of all the petroleum products consumed in the U. S. by all sources. Automobiles used about 70% of the petroleum consumed by all motor vehicles. Increases in transportation energy consumption are due primarily to growth in levels of traffic and shifts to less energy efficient modes. The following tables show energy requirements for transport of freight and passengers. 1/ The efficiencies are typical of the mid-1960's.

Freight Transport

	Btu/ton mile
Pipeline	450
Waterway	540
Railroad	680
Truck	2,300
Airplane	37,000

Passenger Transport

	Btu/passenger-mile
Bicycle	200
Walking	300
Buses	1,200
Railroads	1,700
Automobile	4,500
Airplane	9,700

1/ Eric Hurst, Energy Consumption for Transportation in the U. S., Oak Ridge National Laboratory, June, 1971.

The shift from railroads to truck and airplane in freight traffic and from railroad and buses to airplanes has caused declining energy efficiency. The trend is encouraged by preferential government policies favoring air and highway transport. Low average car occupancy, use of cars for many short trips, and disregard for congestion problems increase fuel consumption and pollution. Factors that have reduced fuel economy in the automobile are weight, air conditioning, automatic transmissions, and the rotary engine. Weight is the single most important parameter affecting fuel economy.

In order to illustrate possible energy savings through use of energy efficient transport modes, one study devised a hypothetical, entirely speculative model which required only 71% as much energy as that actually expended in 1970 to move the same traffic. Although this model ignored factors that inhibit shifts to energy-efficient modes, it shows the magnitude of reduction that is possible. 1/

A report by the Office of Emergency Preparedness 2/ estimated that short-term measures could produce a maximum energy savings in the transportation sector of 1.9 quadrillion Btu per year by 1975, equal

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1/ Improving Efficiency of Energy Use: Transportation and Space Heating and Cooling, op. cit.

2/ Executive Office of the President, Office of Emergency Preparedness, The Potential for Energy Conservation, October, 1972.

to 10% of transportation demand. Such measures would include educational programs, establishment of government efficiency standards, improved airplane load factors, smaller engines and vehicles, improved mass transit, and improved traffic flow. Public awareness of energy conservation and alternatives would foster a clearer understanding of the energy implications of decisions. A change in public attitudes toward walking, bicycling, and mass transit, might do much to reduce demand for energy.

With the exception of the primary metals sector, industrial demand for energy under existing technology could be reduced by 5 to 10% given sufficient economic incentives (possibly price increases or an energy tax). 1/ Industrial energy demand can be cut by recycling metals. For non-ferrous metals the amount of energy required to recycle scrap metal is less than 20% of that required to refine the metal originally although new low energy primary metal extraction methods are in development.

Another way to better match supply and demand for energy is through the price mechanism. In the past, use of natural air, water, and land resources has been virtually free. If a price were put on

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1/ Ibid.

social costs reflecting depletion of resources and damage to the environment, energy would tend to be produced in ways that conserve natural resources. Higher input prices would be passed on as higher output prices, which would reduce demand. This concept underlies such proposals as a tax on auto-emissions, which could be based on number of miles driven and a test on emissions for each vehicle. An alternative form of auto tax could be based on vehicle weight and added to the initial price of the car. An auto tax would make it more expensive to drive a car and encourage use of mass transport. In addition, these taxes would provide incentive to develop cleaner technology.

If the costs of environmental and resource use were better reflected in prices of energy, more informed choices could be made. An electric rate schedule including higher charges for peak period usage would encourage consumers to shift use to other times of day, resulting in more efficient use of existing plants and less construction of new generating capacity to service peak demand.

According to one study, 1/ "Substantial cost increases and reduction in population growth will noticeably lower electricity demand growth

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1/ Electricity Demand Growth: Implications for Research and Development, op. cit.

in the 1980's and 1990's. Given the lengthy time period of response, growth reduction in the 1970's might be limited." The authors give the following preliminary estimates of elasticity of electricity demand for electricity prices, income, population, and gas prices.

Summary of Electricity Demand Estimated Elasticities
for Electricity Prices, Income, Population, and Gas Prices

Factor	Residential	Consumer Class Commercial	Industrial
Average Electricity Price	-1.3	-1.5	-1.7
Population	+ .9	+1.0	+1.1
Income	+ .3	+ .9	+ .5
Average Gas Price	+ .15	+ .15	+ .15
Percent of Response in First Year	10%	11%	11%
Years for 50% of Total Response	8 years	7 years	7 years

The elasticities of demand represent the relationship of the percentage change in electricity demand and the percentage change in the factor. For example, the commercial elasticity for electricity prices of -1.5 means that a 20% rise in average commercial electricity price would in the long run cause demand to be 30% less than it otherwise would have been.

The kind of public policies that would be required to reduce demand, according to Michael McCloskey, Executive Director of the Sierra Club, would include the replacement of the market system to determine how much energy shall be produced or imported and who shall consume energy, with a detailed control on the production, importation, and use of energy in all sectors and regions of the economy. In his evaluations relative to controlling energy growth, he states:

> "A short-run strategy would involve the following changes in public policy: ending or reducing the many biases in public policies which provide incentives to energy growth; maintaining and strengthening environmental constraints on energy growth; reducing energy demands by educating the public to understand the importance of conservative use of energy; encouraging intensified research and development in order to achieve greater efficiencies in energy utilization and in order to find new, more environmentally acceptable energy sources and discouraging growth in industries that are the most profligate consumers of energy. Coordination of these efforts would be facilitated through the establishment of new government agencies, specifically geared to

respond to the energy problem. Each of these changes would involve efforts that would go well beyond the traditional bounds of energy policy, and all could have profound economic and social impacts. Yet changes are already beginning to occur in all these fields, and environmentalists are determined to promote them." 1/

The proposed OCS lease sale is projected to supply approximately 750 to 1050 million cf/d of natural gas by 1985. An evaluation of reduction in demand for natural gas must take into account the present acute shortage of supply. Demand for natural gas is already under restraint due to a variety of controls, including regulatory limitations on new sales (including residential and commercial sales), voluntary restrictions on new sales adopted by gas companies, and the economic restraints inherent in rising retail prices for natural gas. Furthermore, the emphasis being placed on improving air quality is increasing the demand for natural gas because its exhaust contains no sulfur and no particulates. The expected natural gas production from this lease sale would not cause any growth or change in existing patterns of gas

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1/ Michael McCloskey, "The Energy Crisis: The Issues and Proposed Response", Environmental Affairs, Vol. 1, No. 3, Nov. 1971, pp. 587-605.

consumption. Several pipelines supplied by offshore Louisiana wells have been forced to curtail activities below contracted quantities by amounts in excess of the expected production of natural gas from the lese sale. Testimony at the public hearings for the proposed sale stated that pipelines originating in Southern Louisiana and Texas will require an estimated 55 trillion cubic feet of new gas reserves between now and 1980 in order to maintain existing levels of delivery. 1/

If a reduction in demand were directed at the oil and natural gas to be developed from the proposed OCS oil and gas lease sale, all the environmental impacts associated with that development and energy use would be eliminated as a result of the direct tradeoff. It would also eliminate any environmental damages and any adverse results associated with any one of the alternatives to the sale. A major consideration in restricting demand for energy resources is that the cost involved in such a restriction is not related to the environmental damage which would be prevented by not producing, transporting and consuming the energy resources involved. In the case where pollution standards are introduced and enforced, causing the amount of environmental damage to the air per unit of energy produced to decrease radically over the period of a few years, the environmental benefits of the action decline but the associated costs do not.

1/ Testimony of S. Orlofsky for Columbia Gas System Service Corporation, February 17, 1973.

The following table shows the trend in quantities of air pollutants emitted from mobile equipment using petroleum products. 1/

Estimated Emissions From Mobile Equipment
(millions of tons per year)

	1965	1970	1975	1980	1985
Hydrocarbons					
Autos	13.0	11.0	5.9	2.4	0.9
Trucks and buses	1.7	1.9	1.7	1.4	1.4
Aircraft	.2	.3	.2	.1	.1
Off-highway	.7	.6	.6	.6	.5
Total	15.6	13.8	8.4	4.5	2.9
Carbon monoxide					
Autos	55.2	54.3	40.6	24.3	12.7
Trucks & buses	15.6	17.4	16.2	14.0	14.2
Aircraft	.9	.4	.5	.7	.8
Off-highway	5.7	5.3	5.5	4.4	3.4
Total	77.4	77.4	62.8	43.3	31.1
Nitrogen oxide					
Autos	4.8	5.7	5.0	2.8	1.3
Trucks & buses	1.1	1.4	1.6	1.5	1.7
Aircraft	.03	.05	.06	.08	.09
Off-highway	.9	.9	.9	1.1	1.1
Total	6.8	8.1	7.6	5.5	4.2
Particulate					
Autos	.2	.3	.3	.2	.1
Trucks & buses	.1	.2	.2	.2	.2
Aircraft	.02	.04	.04	.04	.05
Off-highway	.2	.2	.2	.2	.1
Total	.5	.7	.7	.6	.5

The impact of the stricter 1968 air pollution standards is quite apparent.

1/ National Petroleum Council (NPC), Environmental Conservation, The Oil and Gas Industry, v. 2, p. 308, February, 1972.

Interpretation of this table shows that an equal reduction in energy demand in 1970 and in 1985 would be more costly in 1985, in terms of energy sacrificed per unit of pollution avoided.

Research and development of more efficient methods of energy extraction and use offer long range possibilities for reduction in the amount of input needed to produce a given energy output. In this regard efforts should be directed toward development of total energy processes through which, for example, waste heat discharges could be used to run turbines, for preheating, drying and space heating. Other promising research areas include fuel cells, magnetohydrodynamics and breeder reactors.

A comprehensive study of energy conservation has just been released by the Office of Emergency Preparedness. 1/ The study considers only user conservation and not improvements in recovery techniques or related government actions. If all the suggested measures are implemented, potential annual energy savings by 1980 could be the equivalent of a total of 7.3 million barrels/day of oil; 2.4 million barrels/day in the residential/commercial sector, 2.3 million barrels/day in the transportation sector, and 2.6 million barrels/day in the industrial sector. It is significant to note the study's conclusion

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1/ <u>The Potential for Energy Conservation</u>, op. cit.

that "while the conservation measures proposed in this report will not, taken alone, eliminate the need for increased oil imports, they can substantially reduce this need." Efforts to reduce demand and develop domestic energy resources must be carried forward together.

12. Combinations of Alternatives

In the interest of clarity of presentation this analysis has discussed separately each potential alternative form of energy as a possible substitute to the oil and gas anticipated from the proposed sale. It is highly unlikely that there will ever be a single definitive choice to be made between any potential energy form and its alternatives. Each may have a role to play; some may make major contributions to our energy supplies, while others may be subordinated to lesser roles. Some alternatives may be developed rapidly; others may evolve more slowly--perhaps to make a more important contribution at a later date. Forecasting on the basis of present knowledge of the relative roles of these potential alternatives is a highly subjective exercise which must necessarily include a large measure of judgment as to future trends in such variables as the direction and pace of technological development, the identification of usable resources, the rate of national economic growth and changes in our life style.

The table which follows this section summarizes the pertinent data developed in other sections of this statement as to the possible alternatives to provide the energy equivalent to that projected for the proposed sale. Examination of this table will facilitiate consideration of possible combinations of alternatives.

It seems most probable that many of the alternatives outlined in the table will be developed to some degree. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the characteristics of our total national energy system. Factors most relevant to the issues at hand are outlined below:

1. Historical relationships indicate that energy requirements will grow at approximately the same rate as gross national product.
2. Energy requirements can be constrained to some degree through the price mechanism in a free market or by more direct constraints. One important type of direct constraint operating to reduce energy requirements is through the substitution of capital investment in lieu of energy; e.g., insulation to save fuel. Other potentials for lower energy use have more far-reaching impacts and may be long range in their implementation--they include rationing, altered transportation modes, and major changes in living conditions and life styles. Even severe constraints on energy use can be expected to only slow, not halt, the growth in energy requirements within the time frame of this statement.
3. Energy sources are not completely interchangeable. Solid fuels cannot be used directly in internal combustion engines;

for example; fuel conversion potentials are severely limited in the short term although somewhat greater flexibility exists in the longer run and generally involves choices in energy-consuning capital goods.

The principal competitive interface between fuels is in electric powerplants. Moreover, the full range of flexibility in energy use is limited by environmental considerations.

4. A broad spectrum of research and development is being directed to energy conversion--more efficient nuclear reactors, coal gasification and liquefaction, liquified natural gas (LNG), and shale retorting, among others. Several of these should assume important roles in supplying future energy requirements, though their future competitive relationship is not yet predictaole.

5. Major potentials for filling the supply/demand imbalance for domestic resources are:

   - More efficient use of energy
   - Environmentally acceptable systems which will permit production and use of larger volumes of domestic coal.
   - Accelerated exploration and development of all domestic oil and gas resources.
   - Development of the Nation's oil shale resources.

Of the foregoing, increased domestic oil and gas production offers considerable possibilities, since indicated and undiscovered domestic resources total some 417 billion barrels of oil and 2,100 trillion cu.ft. of gas which are estimated to be producible under current technology. However, the feasibility of providing adequate incentive and reducing the uncertainties inherent in petroleum exploration is not known.

6. The acceptability of oil and gas imports as an alternative is diminished by:
   - A narrowing gap between costs of foreign and domestic oil.
   - Apparent high costs of liquefying and transporting natural gas other than overland by pipeline.
   - The security risks inherent in placing reliance for essential energy supplies on sources which have demonstrated themselves to be politically unstable and prone to use interruption of petroleum supplies to exert economic and political pressure on their customers.

   The aggravation of unfavorable international trade and payments balances which would accompany substantial increases in oil and gas imports.

Though this section considered the possibility of combinations of alternatives, in view of the foregoing it seems reasonable to postulate that for some time to come the basic alternative to the production of the oil and gas from the sale would be an

equivalent amount of foreign imports. This would be true whether it is considered as an alternative to the entire proposed sale or to any number of tracts deleted from the sale. The problems associated with this alternative have been discussed in the text. Although an equivalent amount of imports appears to be the basic alternative for the foreseeable future (ten to fifteen years), it is difficult to predict what alternatives, or combinations of alternatives, would be feasible in the more distant future. The availability of other alternatives in the more distant future is discussed elsewhere in the text.

SUMMARY TABLE

Comparison of Incremental Production Potential and Cost of the Proposed OCS Lease Sale and Short-Term Alternatives

ALTERNATIVE	PRODUCTION POTENTIAL 1980 Physical Units	1980 BTU (billion)	1985 Physical Units	1985 BTU (billion)	Resource Cost $/barrel of oil equivalent)
Proposed OCS Lease Sale					
i. Oil	5-11 kbbl/d	30-60	5-11 kbbl/d	30-60	1.86-2.03
II. Gas	750-1050 Mcf/d	775-1110	750-1050 MMcf/d	775-1100	1.01-1.24
I. Energy Conservation	(Not estimated)	(Not est.)	(Not est.)	(Not est.)	(Not estimated) 4/
II. Policy - Related Alternatives					
1. Imports					
a. Crude Oil (Persian Gulf)	11 kbbl/d+	1160+	11 kbbl+	1160+	3.47
b. LNG	1050 Mcf/d+	1160+	1050 Mcf/d	1160+	2.75-3.26
2. Natural Gas Pricing 1/	Uncertain	Uncertain	Uncertain	Uncertain	———
III. Physical Substitutes & Alternatives					
1. Onshore Production					
a. Economic incentives to increase domestic exploration	gas: 750-1050 MMcf/d oil.5-11 kbbl/d	1160+	750-1050 MMcf/d 5-11 kbbl/d	1160+	2.24-4.18
b. Wellbore stimulation 2/	gas: 750-1050 oil:5-11 kbbl/d	1160+	750-1050 5-11 kbbl/d	1160+	1.74
c. North Slope 3/	None	None	None	None	———

1/ Gas production might be stimulated to produce production equal to that of the proposed sale.

2/ Assumes ultimate recovery at rate of 1% of additional recoverable reserves per year.

3/ Alaskan oil is not likely to flow before 1976 in subsequent years it will meet deficits in West Coast Markets rather than markets served by this sale.

4/ See text.

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3/ Alaskan oil is not likely to flow before 1976 in subsequent years it will meet deficits in West Coast Markets rather than markets served by this sale.

4/ See text.

2. Nuclear Power	6,000MW	1160+	6,000 MW	1160+	1.74
3. Coal, as a fuel	46,400 tons/d	1160+	46,400 tons/d	1160+	1.65
4. Synthetic Gas (Coal gasification)	1,124 MMcf/d	1160+	1,124 MMcf/d	1160+	4.69
5. Oil Shale	35,000 bbl/d	200	200,000 bbl/d	1160+	3.29
6. Hydroelectric	None	None	None	None	———

C. Delay Sale Until New Technology is Available to Provide Increased Environmental Protection

The sale could be delayed until new technology is available; however, basically safe technology is available provided its application and use are properly regulated and controlled. As new technology relating to safety and environmental protection is developed, it can be incorporated with existing requirements and applied to all OCS leases so that bringing on additional production now will not generally preclude adaptation of new advances to the prospective leases. "Zero risk" does not exist but is an ideal toward which safety systems are directed. In the history of Federal offshore leasing and production over the past 18 years only 10 significant oil spills have occurred in more than 1,500 leases, 10,500 drilling holes, and 1,935 producing platforms.

In addition, the proposed sale could be delayed pending completion of all studies concerning the potential environmental impacts of offshore minerals development in general and oil spills specifically. There are many studies relating to these issues being conducted by the scientific community and industry as well as the government that are of a long-term, ongoing nature. The Bureau of Land Management is initiating long-term, ongoing studies of its own both on an inhouse and contract

basis. A central feature of many of these studies is that they are never really completed in the sense that they rarely reach definite conclusions with wide applicability, but simply advance from one stage to another, from one level of analysis to another, thereby contributing to a growing area of knowledge and body of literature pertaining to the numerous complexities of environmental analysis. To delay the sale on the basis of incompleted studies would require an indefinite delay perhaps of many years duration and would tend to discount information which is already known. Undoubtedly, information gaps and uncertainties will always be associated with offshore minerals development and any delays in such a development program must be judged on the basis of whether or not these gaps and uncertainties are so great, compared with what is known, as to warrant postponement. Moreover, the President, in his Clean Energy Message, called for an accelerated OCS leasing program as one measure to help make available energy resources of Federal lands for national energy needs. Final judgment then must rest on a determination regarding whether or not a delay at this time would be in the nation's best interest.

IX. CONSULTATION AND COORDINATION WITH OTHERS

A. Preparation of the Draft Environmental Statement

1. Federal Participation

In the preparation of the Draft Environmental Statemen information inputs and review comments were solicited from appropr bureaus and offices within the Department of Interior. In additio the Environmental Protection Agency, the Department of Commerce, Department of Transportation, Atomic Energy Commission, Federal Po Commission, and the Office of Emergency Preparedness were consulte at various stages in preparation of the draft statement.

2. State Participation

In the preparation of the Draft Environmental Statemen views on the environmental impact of the leasing proposal were solicited from the following agencies in the States of Texas and Louisiana.

Louisiana
- The Commission on Intergovernmental Relations
- Louisiana Wildlife and Fisheries Commission
- Department of Conservation
- Gulf States Marine Fisheries Commission

Texas
- Office of the Governor
- Texas Division of Planning Coordination
- Texas Parks and Wildlife Commission
- Water Quality Board
- Railroad Commission of Texas

B. Coordination and Review of the Draft Statement Leading to Preparation of the Final Environmental Statement

After the draft statement was prepared, copies were made available to all interested Federal and State governmental agencies and the public. Comments and views were solicited from governmental agencies relative to the draft statement and the proposed action.

In addition, comments and advice were solicited from the public at large, through formal and informal correspondence, and at a Public Hearing held on February 21 and 22, 1973, in Houston, Texas.

1. Federal Agencies

The following section presents a list of all agencies and offices from whom review comments were received. Where appropriate, the disposition of their comments and any unresolved conflicts is also indicated. All comments received from Federal agencies are attached as part of this Final Environmental Statement.

a. Bureau of Outdoor Recreation (BOR)

The BOR requested more detailed recreation maps and raised questions concerning the 0.5 knot shoreward ocean current velocity figure used to determine the proximity scale in the matrix analysis section of the statement.

Disposition

Maps--The maps have been expanded to show more detail of existing as

well as proposed recreation areas. The recreation inventory list presented in BOR's memorandum of January 16, 1973 has been appendec to the Final Environmental Statement. The maps referred to in the Corps of Engineers' report have been consulted and where possible information presented on their maps have been depicted on the maps prepared for inclusion in this statement. The negatives to the photographs contained in the Corps of Engineers' report were not obtainable in time for their inclusion in this statement. Photographs taken by BLM staff members of the beach zone in the study area were, unfortunately, not of suitable clarity and quality for inclusion in the statement.

Matrix--The relative environmental impact scale is simply a device based upon professional judgment, for selecting those tracts that should be more carefully analyzed as to their potential for advers(environmental impact prior to proceding with the actual sale. The scale is relative and was not designed to fulfill the purpose of a concluding classification scale concerning the potential risk each tract might pose to the environment. However, to meet the need fo such a scale, a concluding section titled "Summary Risk Analysis" has been added. This summary section defines three categories and presents conclusions reached as a result of applying the matrix analytical technique to the tracts in this proposed sale.

The BOR questions the integrity of the 0.5 knot shoreward increment of ocean current velocities (i.e., rate of shoreward drift) in the area used in computing a proximity scale. The BOR has equated ocean current velocity with the shoreward component of ocean current velocity, and has converted our stated winter months current velocity of 8 to 13 miles per day to a shoreward rate of drift of 8 to 13 knots. By making these errors the BOR has computed a shoreward rate of drift in the area that would range from 220-360 miles per day(8 to 13 knots). This would be a velocity seldom reached by most rivers even at flood stage. Even the fastest moving stream in all the oceans, the Gulf Stream, only has a top speed up to about 4 knots (110 miles per day). In an effort to eliminate possible future confusion concerning this matter, the section of the statement dealing with ocean currents has been expanded to include more data on currents and winds and all velocities, rather then expressed in miles per day, have been converted to knots. Essentially the 0.5 knot figure used in the matrix analysis is based on the data presented in the ocean currents section of this statement (II. C. 3.). An explanatory footnote has also been added in the matrix section where the 0.5 knot figure is first introduced (see section III. I.).

Debris--The dumping of drill cuttings and sand is discussed in section I. F. 2. but not as it pertains to being transported to beach and recreation areas. Field observations and practical

experience indicates that turbidity moves in a plume in the direction of the current and settles out or dissipates within one mile of the platform or drilling rig. Because the nearest tract in this proposed offering is 12 miles from shore no drill cuttings or sand would be expected to reach beach areas.

Noise and odor--The decibel levels of the noise from equipment, generators, etc. on platforms is not known. However, this noise has never in the past been at a level as to be audible on shore. Also the minimal odor on platforms will not be detectable on shore.

Pipelines--The exact location of pipelines cannot be determined until the precise locations of future production have been delineated. (See section IV. C.). In general, however, any pipelines from production resulting from this proposed sale are expected to be located between East Bay and Sabine Pass.

b. Office of Oil and Gas

The Office of Oil and Gas was consulted routinely in the preparation of this environmental statement. They had no additional comments to make in review of the statement.

c. Geological Survey (GS)

The GS offered several comments for improvement of the environmental statement.

Disposition

All of the suggested changes by GS have been made in appropriate sections of the statement. The suggestions concerning impacts of induced subsidence of onshore areas and subsurface disposal of brine are discussed below:

The disposal of produced oil field waters must be in accordance with the regulations and OCS Orders. The operator's disposal plan must be approved by the Geological Survey Area Supervisor or his representative. In the case of subsurface disposal of waste water, it is generally desirable to inject that water into the formation from which it was produced for the following reasons, but not limited thereto:

1. disposal does not degrade the formation water quality.
2. disposal wells are generally available for injection into that formation (i.e., dry holes, abandoned producers, pressure maintenance wells, etc.)
3. disposal, as a secondary benefit, may aid in the pressure maintenance of the producing formation or may assist in the secondary recovery of oil or gas.

Water disposal into formations other than from where it was produced is not approved unless such disposal tends to improve that formations water quality. (See also section I. F. 3. b. of this statement.)

Because removal of fluids (water, gas or oil) has resulted in recogni subsidence in various geologic situations (Poland and Davis, 1969), the possibility of subsidence and its effects on the environment have been considered for the offshore leases involved in this proposed sal

Onshore effects from the development of the leases will be negligible if even detectable by standard surveying methods. The lack of any appreciable subsidence effects onshore can be predicted on the basis a number of factors, including the following:

(1) The distance from wells to shore will be comparatively great-greater than the radius of noticeable subsidence in the vicinity of similar oil fields located onshore, where careful mapping of the effects was feasible (Poland and Davis, 1969). Distances to shore for the nearest tracts to be offered for lease are greater than 10 miles. Most lie between 50 and 120 miles from shore. Subsidence effects diminish radially outward from centers of withdrawal; radii of effect for oil and gas withdrawals are typically less than those for withdrawals of water from aquifers.

(2) Typical quantities of oil, gas and associated formation water withdrawn in a given time span from the principal oil producing formations in nearby fields (Gardner, 1952, espe-

cially pages 20-28, 45-74, 85-111, and 165-176) have been comparatively small compared to the large withdrawals of ground water in the Houston-Galveston area, where subsidence is progressing rather rapidly. For example, withdrawals of ground water in the Houston-Galveston area have an average daily volume about 400 to 800 times as great as that of fluid withdrawals from the largest oil field in Galveston County.

(3) The permeability of the principal oil-producing formations--although fairly good from the standpoint of typical oil-producing formations (e.g., 500 to about 1,000 millidarcys)--is very low compared to that of the fresh-water bearing formations from which the large withdrawals have been made in the Houston-Galveston area.

(4) The porosity of the principal oil-producing formations appears to be on the order of 28 or 30 percent, according to reports from adjacent fields (Gardner, 1952, p. 105, 166). The portion of subsidence attributable to elastic deformation decreases with increase in porosity (Poland and Davis, 1969, p. 192, eq. 2). Plastic deformation by compaction of fine-grained sedimentary rocks can ultimately be much greater than the elastic but again maximum effects have generally been noted

relatively near producing wells, where subsidence is due to withdrawal of oil.

(5) Anticipated depths to principal producing zones will be sufficinetly great (Brooks, 1968, page T.G.C.-11; Gardner, 1952) to cause upward diminution of compactiong effects and consequently of surface subsidence.

(6) Secondary recovery methods and repressuring are anticipated in production schedules; these practices can largely counteract subsidence effects.

References

1. Brooks, R. P. (Ed.). 1968. Ira Rinehart's Yearbook 1968; Dallas, Rinehart Oil News Company.

2. Gardner, F. J. 1952. Reference report on the Oil and Gas fields of the Texas upper Gulf Coast Railroad Commission District Three: Houston, Five-Star Oil Report. 484 pages.

3. Poland, J. F., and Davis, G. H. 1969. Land subsidence due to withdrawal of fluids. In. Reviews in Engineering Geology II. Geol. Soc. America. p. 187-269.

d. Bureau of Mines

The comments of the Bureau of Mines have been considered in preparation of the Final Envrionmental Statement. (See especially section VIII. B.2.)

e. Atomic Energy Commission (AEC)

All of the review comments of the AEC have been incorporated into the Final Environmental Statement.

f. Office of Emergency Preparedness (OEP)

The changes suggested by the OEP were made in the appropriate sections of the environmental statement.

g. National Park Service (NPS)

The NPS reviewed the Draft Environmental Statement and had no recommendations concerning changes in the statement. Tl suggestions made in the final paragraph of NPS's review comments h. been brought to the attention of the New Orleans based Environment. Assessment Team.

h. Bureau of Sport Fisheries and Wildlife (BSF&W)

The BSF&W expressed concern regarding environmenta analysis of pipelines which result from OCS lease sales. They sug, that a good way to accomplish such and analysis "... may well be a environmental impact statement covering individual or groupings of

major oil or gas trunk lines which eminate from a certain OCS reservoir or result from a specific lease sale."

The concern expressed by BSF&W is shared by the Bureau of Land Management. The BLM's increased emphasis on pipeline planning is reflected in the priority this subject has received as a project for the environmental assessment team in New Orleans (see section IV. C. of this statement). The environmental assessment team recently completed a preliminary environmental analysis of the impact of pipeline construction on coastal resources in the eastern Texas area. In addition to the projects concerning this matter mentioned in section IV. C. of this statement, each pipeline resulting from OCS development and going ashore will be analyzed, prior to issuing a permit, to determine if an environmental impact statement should be prepared.

i. Department of Commerce

All of the review comments of the Department of Commerce were given careful consideration in preparation of the Final Environmental Statement.

Disposition

Page 1, para. 3. Appropriate symbols have been added to show that these grasses do indeed exist in the study area.

Page 1, para. 4. All of the studies cited in this paragraph have been consulted. Information from Moore, Brusher and Trent has been incorporated into the description of the continental shelf anc neritic waters. Information from the other papers cited have not been directly incorporated into the statement. For those desiring more detailed information, the publications listed by the Departmer of Commerce should be consulted. Data on catch-effort by isopleths for the OCS region under study have been incorporated into the statement.

Page 2, para. 1. See sections II. D. 2. c., III. B. 5., and IV. D

Page 2, para. 2. The bibliography is a compilation of sources actually cited in the text of the appropriate section and not a suggested reference list. Those interested are encouraged to consult the two references suggested by the Department of Commerce.

Page 2, para. 3. and top of page 3. Reference to this citation has been removed from the statement.

Page 3, para. 2. See section III. B. 5.

Page 3, para. 3, 4, and 5, and page 4, para. 1. The Department of Commerce has presented in these paragraphs a listing of various studies relevant to dredging activities in shallow waters in the

Gulf of Mexico area. Although these studies are very helpful to an understanding of the environmental effects associated with dredging activities in sensitive areas they are not applicable to operations that are expected to result from this proposed action presented in this environmental statement. For instance, the Brehmer paper discusses sediment disturbance in estuaries and examines the effects of turbidity, siltation and suspended solids in general on estuarine communities. Operations resulting from this proposed sale will not extend to estuaries, will not go through oyster beds and will not take place in areas where organic matter in sediments is a potential problem. The Boca Ciega Bay, Florida study (Sykes and Hall, 1970) examined the effects on bottom sediments of a real estate project in which a rectangular area estimated to be 2,560 acres or 4 square miles was completely disrupted by dredging and filling. Some sediment deposits were estimated to be up to 4 meters deep. In contrast, pipelines expected to result from this proposed sale will involve hydraulic dredging only in the open Gulf where currents restore the original terrain in a few weeks to a few months. There will be no lasting sediment deposits and the moderate to severely disturbed area will be concentrated in a band approximately 30 feet wide. Therefore, the dredging associated with this proposed sale will not create an expanse of biological desert in which recolonization would be slow. Likewise,

Odum's study involved a measure of the effects caused by dredging ar Intracoastal Channel at Redfish Bay, Aransas Pass, Texas. The dimer sion of this channel excavation was 125 feet wide by 12 feet deep. we assume an existing water depth of 2 feet then 100 yards of dredgi for the Intracoastal Channel displaced about 14,000 cubic yards of s ments in this closed bay system. In contrast, a pipeline for an equ distance of 100 yards would involve the displacement of about 330 cu yards of sediments. Furthermore, the primary concern of Odum's pape was the effect of dredging on the productivity of a Texas turtle gra community. There is no such community in the area where pipelines resulting from this proposed sale will be placed by hydraulic dredg:

The effects of pipeline construction expected to result from this sa are presented in section III. B. 3. of this statement. Additional discussion can be found in sections I. F. 4, and IV. C.

Page 4. para. 2. The Office of the District Commander, U. S. Coast Guard, New Orleans was consulted concerning this matter. At presen it is believed that current regulations concerning this matter are adequate. Special lighting and fog signal requirements for structu on or adjacent to navigable channels and fairways are provided in Parts 67.05-25 and 67.10-10(b) in the Coast Guard's "Rules and Regulations for Artificial Islands and Fixed Structures on the Oute Continental Shelf", dated July 1, 1972.

Page 4, para. 3. The recommendation that a new category be included in the matrix analysis to account for an intensive single-species fishery out to a depth of 210 feet (35 fathoms) has been adopted (see section III. I. and J.).

Page 5, para. 1. All waste disposal must conform with all applicable state and Federal regulations. Appropriate language has been added in section IV. A. 1. Also see Attachment G for the appropriate OCS Operating Order concerning this matter.

Page 5, para. 2. There are no tracts in this proposed sale within one mile of live coral reefs. However, see section IV. D. for a special stipulation concerning development of those tracts in the vicinity of Stetson Bank. The issue raised concerning stipulations for protection of snapper and grouper banks is unresolved because we have no evidence that indicates exploration and construction operations within one mile of these numerous banks have been environmentally damaging or have retarded the utilization of the snapper and grouper resource. It has not been determined that these banks merit protection by special stipulations which would be outside and in addition to the protection they receive through normal operating practices under existing rules and regulations.

The suggestion that the stipulation concerning platform placement also be applied to the South Additions and Extensions has been adopted. In other words, this stipulation will apply to all tracts in this pro-

posed sale regardless of water depth, miles from shore, and proximity to a major commercial fishing zone. Concerning Coast Guard requirements for marking and maintenance of underwater stubs see sections I. F. 2. b. and IX. B. 2. a.

Page 5, para. 3. All pipeline permit applications submitted as a result of this sale will be subjected to an environmental analysis to determine the effects such an action would have on the environment. If the right-of-way permit application indicates it will seek a route through known snapper and grouper banks a determination will be made at that time concerning its potential effects on snapper and grouper resources (see section IX. B. 1. h.). See section IX. B. 2. a. concerning navigational aids for unburied pipelines in water greater than 200 feet.

Page 5, para. 4, and all of page 6. Appropriate language has been added to reflect the information presented in these paragraphs.

j. Environmental Protection Agency (EPA)

All of the review comments of the EPA were given careful consideration in preparation of the Final Environmental Statement.

Disposition

Para. 1. It was erroneously reported in the Draft Environmental Statement that "jack-up" drilling rigs were used in waters less than 30 feet This should have read in waters less than 300 feet deep. This error h. been corrected in the Final Environmental Statement.

The following discussion is in response to the question concerning the maximum water depth at which platforms can be safely used: The primary limiting factors for the maximum water depths that platform rigs can safely be used are engineering (strength of materials) and economics. A platform rig can be safely used in whatever water depth a platform can be safely erected. In the Gulf of Mexico area, one platform is located in 373 feet of water at West Delta Block 152, while another is located in 300 feet of water at South Pass Block 65, with 57 oil and gas completions. There are numerous platforms in water depths of 200 feet+ where drilling operations are presently in progress without any decrease in safety.

Some operators have discussed with the Geological Survey platform designs for 600 feet water depths in the Gulf of Mexico, although none of these plans have resulted in a platform application at this time.

Exxon has submitted for the Santa Ynez Unit in the Santa Barbara Channel to the GS for review and approval plans which include platform installations for drilling and production operations in water depths of 850 feet.

Industry has indicated that economics is the only factor limiting the water depth at which platforms may be safely installed and operated. Industry engineers knowledgeable in the field of platform construction

have stated that without money constraints a platform could be built for safe operation in almost any water depth that may be encountered in offshore oil and gas operations.

Bottom stability has been included in the tract-by-tract analysis. See section III.K.

Para. 2. Agencies having authority over the structures mentioned in this paragraph would be the U.S. Army, Corps of Engineers at the beac line; the Louisiana Department of Public Works where they cross navigable water ways in Louisiana; and, the private land owners who have entered into contractual arrangements with industry for the maintenan of bulkheads on their lands. BLM's environmental assessment team in New Orleans, and the Geological Survey, New Orleans, in routine surve ance to and from offshore or nearshore areas, report any breaks in th structures to the pipeline companies or, if known, to the landowners.

Para. 3. OCS Order No. 7 (see Attachment G) requires that drilling mud containing toxic substances must be neutralized prior to disposal into the Gulf waters and absolutely bans the disposal of oil-base mud into the Gulf.

The toxicity of drilling muds is relatively low and limited quantitie are disposed of upon completion of drilling operations at a location. The use of oil-base muds has been reduced considerably due to the availability of mud additives that provide the desired mud system characteristics. These additives are biodegradable and not harmful t aquatic life.

The 92d Congress enacted two laws, the Federal Water Pollution Contr Act Amendments of 1972 (P.L. 92-500; 86 Stat. 816) and the Marine

Protection, Research, and Sanctuaries Act of 1972 (P.L. 92-532; 86 Stat. 1052), either or both of which may be applicable to oil and gas operations on the Outer Continental Shelf. The Department recognizes the EPA's responsibility under these Acts and intends to cooperate and offer its expertise in the implementation of the requirements made applicable by the Acts to oil and gas operations on the Outer Continental Shelf. We are particularly concerned with the impact of solid and liquid discharges from OCS oil and gas operations into surrounding waters and to the extent such discharges are subject to control by provisions of these Acts and implementing guidelines the Department will take all necessary measures to ensure compliance with such requirements.

Para. 4. See the footnote in section III.B.1. wherein it is noted that the use of PCB's in offshore areas has been banned for all future use and existing PCB concentrations must be removed by June 1, 1973 from all offshore facilities in Federal areas.

Para. 5. It is possible in most cases to remove pipelines after they are abandoned but as the size of the line increases, the difficulties and potential environmental effects associated with removal far outweigh the potential hazard of leaving the line in place. It is common in the Gulf of Mexico for pipelines to cross or be crossed by other lines. Depending on what line is to be removed, these crossing points

do present significant problems. If the pipeline is completely purged with water and cut off at both ends below the mudline, it does not present a hazard and need not be removed.

Para. 6. Engineers with the Geological Survey and representative the Offshore Operators Committee have indicated that bottom subsi dence due to oil and gas extraction is not a problem in the OCS (of Mexico. The majority of oil and gas reservoirs in this area h a water drive mechanism; therefore, water replaces produced oil a gas and no voidage is created. Those depletion drive reservoirs usually result in secondary recovery projects with water and/or g injection sweeping the pore space and replacing produced oil and Of course, any time oil and gas is extracted there is always a po bility for subsidence and the potential for subsidences increases inversely with the depth of withdrawal. Accordingly, subsidence a factor taken into general consideration in the design criteria platforms and pipeline installation, but perhaps due to relativel deep oil and gas producing horizons, it has never been encountere or been a problem in the OCS in the Gulf of Mexico. See also the discussion in section IX. B. 1. c. of this statement.

Para. 7. In response to EPA's and other agencies' comments conce this matter, the current velocity discussion has been expanded (s section II. C. 3.). Moreover, clarification has been added by i

fying the rate of shoreward drift as the key component of ocean current velocities which are pertinent to nearshore or onshore resources. See section III. I. "Scale of Importance" and our reply to the BOR in section IX. B. 1. a.

Para. 8. The term "frequent" could be expressed as daily for multi-well unmanned platforms and semi-weekly to weekly for single well structures. These expressions are only general because the frequency of inspections necessarily depends on many factors which include but are not limited to producing or shut-in wells, oil or gas production, unusual physical properties, measurement modes, pressures, weather, development activity, age of equipment, etc.

Para. 9. Waste Disposal - The December 1972 addendum to the Offshore Operators Committee Status Report on Water Treating Facilities supplements and updates the February 1972 report. These reports were made in conjunction with EPA representatives and several copies have been placed in various EPA offices, including Washington. The report and data demonstrate that water treatment equipment and technology have not improved greatly in the past year or so. There are some locations disposing of produced water where the treatment equipment puts out an effluent with less than 25 ppm oil content, but the facts also show that this control is not being accomplished across the board

on a continuing basis. Therefore, in the opinion of the Geologica Survey "best practicable" control technology presently available does not conincide with the EPA's opinion. To this extent then, this remains an unresolved issue.

It is believed at this time, that the "best practicable" control technology is being provided by the majority of operators in the Gulf of Mexico. Research is being conducted in this area of opera tions and it can be expected that industry will utilize "best practicable" control of effluent waters currently available.

Para. 10. The potential adverse environmental impacts that could result from development of the nine oil or oil and gas prone tract have been extensively analyzed in section III. of this statement. In section V. A. it has been stated that these particular tracts should be given careful scrutiny prior to any decision to hold the sale as proposed. Section VIII. A. considers the offering of gas prone tracts only as an alternative to the sale as proposed.

Attachment G contains the OCS Operating Orders and Notices applic to pollution prevention, control measures and environmental claus A sample lease has been included in the appendix - see Attachment

k. <u>Department of Transportation - Coast Guard</u>

The Coast Guard recommends that tracts with a hig relative environmental impact factor be considered for removal fr this proposed sale.

Disposition

The alternative to hold the sale in modified form by removing all oil prone tracts from this sale is discussed in section VIII. A. See also sections III. I., J. and K. for analysis of potential environmental impact of all tracts proposed for offering in this sale.

2. State Agencies

a. Texas

Comments were received from the Executive Department Division of Planning Coordination; Texas Parks and Wildlife Departme (TP&WD); the Texas Air Control Board; and, the Texas Water Developme Board.

Disposition:

The TP&WD recommends that "more substantial, lighted buoys" should be used in marking underwater completions and "it shou also be the obligation of the company to regularly check to be sure the buoy is on location and functioning properly." Without these co ditions, the TP&WD recommends that no underwater completions be allo The U.S. Coast Guard, 8th District in New Orleans was consulted con ing this matter and it was learned that:

1) Private aids to navigation are required by the U.S. Coast Guard District Commander on underwater completions. A lighted buoy is required for underwater completions in less than 85 feet of water. Unlighted buoys are required for underwater completions in 85-200 feet of water unless they are within 500 yards of a shipping fairway wherein they would be lighted.

2) The owner is responsible for maintenance and proper functioning of these private aids. Any malfunctions or

unmarked underwater completions in less than 200 feet of water should be reported to the Coast Guard and to the owner, if known.

3) The Coast Guard is studying this matter and expects to complete its study within the next six months. The Chief, Branch of Environmental Analysis, BLM the Coast Guard and other representatives of Federal agencies attended a meeting with commercial fishermen in Tampa, Florida on March 22, 1973. At this meeting, the fishermen were requested to provide evidence concerning time, place, and dates together with damage done to their equipment and property as a result of underwater stubs and pipelines. Until such facts are known, the dimensions of the problem can not be determined and appropriate action taken. This matter will continue to receive attention and appropriate action will be taken if the facts and circumstances warrant it.

The TP&WD also suggests that unburied pipelines beyond 200 feet in water depth should be marked with lighted buoys or range lights. At the present time the Coast Guard does not require marking on submerged structures beyond 200 feet in depth. Until such time as

evidence can demonstrate that unburied pipelines beyond 200 feet in depth are a hazard to property, no buoy, range lights, or marking specification will be required.

The TP&WD requests that the coral banks should receive adequate protection from drilling operations. See the discussion and special stipulation in section IV. D. 1.

Texas Air Control Board's (TACB) review comments have been conside in preparation of the Final Environmental Statement. The informat concerning air quality has been incorporated in the statement (see especially section III. C. and VIII. B. 2.). We have acknowledged possibility of air quality degradation from both massive and chron low-level oil spillage in section III. C.

We have re-examined Dr. Oppenheimer's study (the source of the "me volatility of 44% as determined in the laboratory") and have deter that he was not trying to simulate an oil spill on the ocean. The fore, in the absence of additional information, we are now conside 15% evaporation (Chevron spill, 1970) to be a realistic value.

The Texas Water Development Board was complimentary of the stateme and voiced no objection to the sale.

b. Alabama

The Alabama Development Office acknowledged receip the Draft Environmental Statement but submitted no comments concer the proposed action.

c. Florida

The Department of Administration forwarded review comments from the Board of Trustees of the Internal Improvement Trust Fund; Department of State - Division of Archives, History and Records Management; and, Department of Legal Affairs - Office of the Attorney General. (Copies of these letters are attached.) In addition, the Department of Health and Rehabilitation Services - Division of Health, and the Department of Natural Resources reviewed the Draft Environmental Statement and reported "no adverse comments". The Game and Fresh Water Fish Commission reviewed the Statement and recommended that alternative A (Hold the Sale in Modified Form) be adopted. The Department of Legal Affairs also recommended adoption of alternative A.

Disposition:

All of the comments from the Florida agencies were considered in preparation of this Final Environmental Statement. Specific responses to questions raised or recommendations issued by the Division of Archives, History and Records Management, and the Board of Trustees of the Internal Improvement Trust Fund are as follows:

The State archeologist and Chief of the Bureau of Historic Sites and Properties (Division of Archives) suggested that magnetometer surveys of pipeline routes should be conducted. In his opinion this "will prevent destruction of any shipwrecks that might be present in

the project area." Standard industry practice includes the use of magnetometer surveys along the pipeline routes. Resultant anomalies are closely examined primarily for the purpose of determining exact locations of existing pipelines that might have to be crossed in lay ing a new line. Any sunken, metal hulled ships would also be detect and appropriate measures would be taken to avoid the wreck, However magnetometers probably could not detect sunken, wooden hulled ships, such as old Spanish galleons. See section II. E. 1. c. (ii) for measures being taken to protect submerged sites of historical and archeological value. In addition, a special stipulation concerning this matter has been presented in section IV. D. 1. of this statemer

The Executive Director of the Board of Trustees of the Internal Improvement Trust Fund raised questions concerning cost/benefit analysis of the offshore oil industry. Concern was expressed regard the accelerating costs of offshore oil and gas production compared w the value of the production. Rising costs of oil and gas productior are well documented by industry sources, For example, an article ir Offshore, February 1973 stated that total platform costs (without ac ment for inflation) have increased from about \$11 million in 1960 tc \$22 million in 1970 and \$36 million in 1972. About three times as n barrels of oil as in 1960 must now be produced to recover total plat costs. However, the open question of how to satisfy current levels

energy demand, let alone higher levels, must be balanced against these costs. Although OCS oil and gas development is expensive, it offers one of the most promising domestic energy sources, especially in the short-term. Costs are also rising in foreign areas where political uncertainties must be considered. The willingness of industry to acquire and develop offshore leases can only be interpreted as a judgment that OCS exploration and production is economically advantageous. Costs of other energy sources are still higher than offshore costs. In the long-term, with technological improvements and more intensive research efforts, perhaps other energy sources will become more competitive. Rising costs in oil and gas drilling have already resulted in industry projects to supplement conventional oil and gas supplies through LNG, and SNG. However, both oil industry actions and public demand for energy indicate that the benefits of offshore leasing outweigh the costs. Recognizing this implicit fact, the Department has not undertaken a detailed cost/benefit analysis per se, but the following sources do present information concerning benefits and costs:

1. Foster Associates, Inc., "The Demand for and Supply of Petroleum and Natural Gas from the Outer Continental Shelf of the United States, Section B - Petroleum Demand and Supply," prepared for United States Department of the Interior, Bureau of Land Management, Washington, D. C. May 8, 1970. That report updates the statistics in an earlier report

prepared by Foster Associates and issued as Bureau of Land Managem
Technical Bulletin 5, "The Role of Petroleum and Natural Gas from
Outer Continental Shelf in the National Supply of Petroleum and
Natural Gas," Washington, Government Printing Office, May 1970.

2. U. S. Department of the Interior, "An Analysis of the Economic and Security Aspects of the Trans-Alaska Pipeline," Vol. III, Marcl 1972, (order No. PB207-254). See especially pages VI-44 to 46.

3. U. S. Department of the Interior, Question and Policy Issues Related to Oversight Hearings on the Administration of the Outer Continental Land Act to be Held by the Senate Committee on Interio and Insular Affairs, Pursuant to S. Res. 45, (March 23, 1972).

The Game and Fresh Water Fish Commission and the Department of Leg Affairs recommended that only gas prone tracts be offered in this sale. For a discussion of this alternative see section VIII. A. Acceptance of this alternative would result, overall, in a lesseni of environmental impacts than those that would result from the off ing as originally proposed. The criteria used in selecting the tracts in this proposed offering are presented in section I. E.

d. Mississippi

The State of Mississippi acknowledged receipt of t Draft Environmental Statement but had no comments concerning the proposed action.

e. Louisiana

Mr. Clint Pray, Assistant to the Governor of the State of Louisiana; the Commissioner of the Department of Conservation; and, the Assistant Director of the Louisiana Wildlife and Fisheries Commission offered testimony at the public hearing in Houston in favor of the proposed action.

3. Public Views and Comments

a. Public Hearing Testimony and Record

On February 21 and 22, the Department held a public hearing in Houston, Texas for the purpose of receiving views, commen and suggestions relating to the Proposed 1973 Outer Continental Shel (OCS) East Texas General Lease Sale.

Presiding over the hearing was Administrative Law Judge Malcolm P. Littlefield; Curt Burklund, Deputy Assistant Secretary for Land and Water Resources chaired the hearing panel which consisted of Donald Truesdell, Chief, Branch of Environmental Analysis, Bureau of Land Management and Richard Waller, Fish and Wildlife Administrator, Bureau of Sport Fisheries and Wildlife. Backing up the hearing pane were representatives from the Washington Office of the Bureau of Lar Management and the New Orleans Office of the Geological Survey.

Eighty-three persons representing state and local government units, the petroleum and related industries, utility and service companies universities, professional organizations, citizens' organizations, etc. presented oral and/or written testimony during the two days of hearings in Houston. Of the 72 presenting oral testimony, 54 submitted written copies of their testimony and 20 presented additiona supplementary material. Eighteen individuals were requested to sub mit additional material for clarification of their presentation or for information to be used by the Department in its environmental impact analysis.

In addition, seventy-one persons including congressmen, state and local government representatives, and gas distributors mailed in material asking that it be made part of the Hearing Record.

Supplementary material included such items as graphs, charts, statistics, photographs, resolutions, reports and maps pertinent to the factors being analyzed in the environmental impact statement.

All testimony received at the public hearing favored holding the East Texas Offshore Lease Sale. No opposition was expressed; some individuals expressed reservations and requested that particular measures be taken to protect specific areas included in the proposed offering.

Testimony at the hearing addressed the following topics:

Energy Crisis - Shortage of Natural Gas

1. Numerous individuals favoring the proposed lease sale reiterated recent incidents and statistics indicating that the "energy crisis" is now upon us. Among the examples cited were: a) the fuel shortages of the past winter throughout the country which left citizens without heat in their homes, factories and schools; b) lack of gas supply resulting in the curtailment of contract deliveries to consumers; projections indicate that this situation will continue, or worsen, if measures are not taken to

expedite the exploration and development of new reserves to help balance supply and demand; c) the fuel shortage has resulted in growing imports from foreign sources. Texas which is one of the Nation's largest producers of oil and gas had to import oil this past winter. In 1971, 1 million tons of crude were imported into Houston. Many expressed reservations concerning the security of these ever-increasing foreign supplies; d) the alternatives to the proposed sale with the exception of imports, did not appear to be feasible in meeting short-term energy needs.

Environmental Impact and Compatibility of Uses

1. Individuals testifying indicated that there would be little adverse environmental impact if the proposed sale were held. Amor the reasons cited for this were the regulatory practices of the Federal authorities and the safety and anti-pollution efforts of industry.

2. Numerous people stated that the overall environmental impact of the proposed sale, consisting mainly of gas prone tracts, would be beneficial. Not only would the sale add needed gas reserves t(the energy supply, but also it would contribute to better overall air quality because of the clean-burning characteristics of gas.

3. Individuals from Louisiana, which has the majority of offshore production, indicated that the oil industry has existed with little conflict or adverse effect on commercial fishing, sport fishing or academic research uses of the Gulf. The benefit of platforms as artificial reefs for sport fishing activity was cited by a number of individuals. Local communities in Texas which had previously expressed reservations concerning drilling in areas off their shores, which began a year or so ago, now feel assured that operations can take place with no adverse impact on the environment, and can be compatible with other user groups.

4. Representatives from the academic community went on record as saying that at this point in time they knew of no long-term adverse effects of oil and gas development on the marine environment.

5. Testimony submitted on the environmental impact of pipeline development in the Texas marshes indicated that the impact was temporary (short-term). Testimony indicated that unlike the construction of pipelines in Louisiana, pipeline construction in the Texas coastal area would not require the use of canal type ditches because of the firmer soil.

6. One person testifying expressed concern over the use of polychlorinated biphenyls (PCB's) as heat exchangers in offshore installations.

The use of PCB's on the OCS has been under study within the Depart-
ment for the past few months. As a result of this effort and coincidental to the hearing, an announcement was made that the Geological Survey in a Notice to all OCS Lessees and Operators dat February 16, 1973 banned the use of PCB's on the OCS because of potential adverse environmental effects.

7. A number of individuals indicated that special consideration should be given to the development of tracts on, or in, the vicini of the unique coral reefs of the East and West Flower Garden areas and the more limited growth of corals on Stetson and, Claypile Ban A number of recommendations were made regarding the proximity of drilling to these unique areas, the disposal of waste products (in relation to Stetson and Claypile, specifically) and the handling o an oil spill should one occur. (See sections II. D. 2., III. B. 5 and the special stipulation in section IV. D. 1.)

Local and Regional Economic Impact

1. Numerous individuals indicated the beneficial impact of offsho oil and gas development on the employment, income, and tax base of the local and regional economies. Statistics supporting the impac were submitted for the record.

2. The work force of refineries, petro-chemical plants, drilling firms, equipment manufactures and other numerous and related servi industries are dependent on a substantial level of offshore activi

Individuals indicated that recent delays in offshore leasing have caused fluctuations in the manpower and equipment markets creating a shift to other areas outside the Gulf.

The numerous specific comments associated with the above broad topics discussed at the hearing were considered in the preparation of the final statement. In some cases, specific information presented in connection with the public hearing has been incorporated directly into the statement.

A list of all persons and their respective affiliations who submitted testimony orally or in writing for the hearing record are contained in Attachment I, Tables 1 and 2. All public hearing testimony, exhibits, and records, are available for inspection at the Bureau of Land Management Office of Public Information, Washington, D. C., and the Bureau's New Orleans, Louisiana OCS Office.

b. Other Public Comments

In addition to testimony, oral and written, specifically submitted for the Public Hearing Record, comments were receiv from the petroleum industry, utility companies, and others, includi private individuals expressing their views on the proposed sale. These comments were also taken into consideration in the preparatio of the final statement.

The Natural Resources Defense Council reviewed the Draft Environmen Statement and due to the substantial content of their comments they have been treated separately and their comments have been attached part of this Final Environmental Statement.

Natural Resources Defense Council, Inc. (NRDC)

The NRDC did not submit comments specifically in review of the Draft Environmental Statement (DES 73-1) prepared for the proposed Eastern Texas OCS sale. Instead, the NRDC re-submitted two sets of comments prepared earlier concerning a sale offshore Louisiana which was held in December, 1972. The NRDC requested that these two sets of comments, dated August 29, 1972 and November 22, 1972, be considered in preparation of this, the Final Environmental Statement for the proposed Eastern Texas OCS sale. The NRDC's comments have been attached to this environmental statement.

The following discussion will be divided into two parts. The first concerns NRDC's comments dated August 29, 1972 which were previously submitted in review of the Draft Environmental Statement (hereinafter referred to as DES 72-72) for the offshore Louisiana sale held in December, 1972. The second part of this discussion concerning NRDC's comments dated November 22, 1972 which were previously submitted in review of the Final Environmental Statement (hereinafter referred to as FES 72-37) for the same offshore sale held in December, 1972.

Disposition - NRDC's Comments of August 29, 1972

All of the NRDC's comments were considered in preparation of FES 72- They also have been considered in preparation of DES 73-1 and in preparation of this Final Environmental Statement for the proposed Eastern Texas OCS lease sale. The issues raised by NRDC are discuss as follows:

1. Tract Selection - a discussion of the tract selection proces was included in FES 72-37, (see pages 487-488) DES 73-1 (see pag 27-30), and has been included in this statement as well (see section I. E.).

In addition answers to specific questions raised on page 3 of NRDC's comments on the Louisiana General sale are discussed below as they relate to the Eastern Texas proposal:

(1) Resource reports and/or related data were requested and received from various Federal and State agencies, beginning with the announcement of the tentative schedule through the intial drafting of this environmental statement. In areas where leasing is currently being conducted on the OCS in the Gulf of Mexico (i.e., Louisiana and Texas) resource reports are usually limited to updating the reports and data previously submitted by these agencies. In areas where initial

leasing is being considered (i.e., Mississippi, Alabama and Florida) summary reports are much more comprehensive.

(2) & (4) The Bureau of Land Management issued a call for nominations in December, 1971 (Federal Register Vol. 36, No. 231).

(3) Nominations were received from 39 oil companies for the leasing of approximately 5.2 million acres. Because of the proprietary and confidential nature of the data, individual company nominations are not disclosed.

(5) The Geological Survey made recommendations concerning tracts to be offered in accordance with the criteria and procedures of the joint BLM-GS tract selection agreement which is summarized in Section I. E. of this statement.

(6) This environmental impact statement and references cited herein contain the views and recommendations of other Federal agencies and the public on the proposed lease sale. In addition, BLM will submit recommendations to the Secretary prior to any decision on this sale.

The questions on page 5 of NRDC's comments have been responded to in section I. E. of this statement. Moreover, on October 12, 1972, the BLM submitted a detailed reply to the NRDC's specific questions concerning the tract selection process.

2. Consultation - these issues pertain to the Louisiana sale held last December and have been discussed on page 489 of FES 72-37.

3. Evaluation of Alternatives - The Department's response to these issues can be found in FES 72-37 on pages 490 and 491 and in the changes reflected in section VIII of the same environmental statement. However, some of these issues were subsequently raised again in NRDC's review comments of November 22, 1972 and will be discussed below in context of the disposition of those comments in this Final Environmental Statement.

4. Environmental Impacts - All of the issues raised under this heading have been addressed on pages 491-496 of FES 72-37 and appropriate sections of that environmental statement. Moreover, section III. of DES 73-1 dealing with environmental impacts was completely reorganized and rewritten and is not the same as that

appearing in FES 72-37. In addition, this section (i.e., section III.) has once again been reorganized and rewritten for this Final Environmental Statement. This reflects an effort to be responsive to new information and to present significant results of environmental studies and advances in technology relevant to the proposed action and the area under study as they become available.

Disposition - NRDC's Comments of November 22, 1972

The second set of the NRDC's comments dated November 22, 1972 were in review of the Final Environmental Statement (FES 72-37) previously mentioned above, and were considered by the Department prior to holding the sale in December, 1972. However, because some of the issues raised in this set of comments are believed to be relevant to the Draft Environmental Statement (DES 73-1) presently under review and applicable to the preparation of the final statement for the proposed Eastern Texas oil and gas sale they are discussed below.

1. Tract Selection - A section on tract selection has been included in this statement (see section I. E.). Answers to specific questions have been responded to as previously indicated.

2. Lease Only Gas-Producing Tracts - The alternative to lease gas prone tracts only is discussed in section VIII. A. of this statement.

3. Reduction of Growth in Energy Demand - In recognition of the need for more centralized energy planning, Departmental reorganization calls for the establishment of an Office of Energy Conservation under the Assistant Secretary of Energy and Minerals. This office will be concerned with the promotion of public awarene

and participation, research, and development, and adoption of more efficient technology and energy conservation measures

4. FPC Pricing - Economic studies and deregulation have beer mentioned in this section. The Department is currently participating in a Task Force studying options with regard to deregulation of well-head prices and legislation to this end has been introduced in Congress. To date, no final conclusic have been reached or actions initiated.

5. Oil Imports - The possibility of underground storage of imported oil was mentioned at the public hearings in Houston. It was the opinion of Dr. John McKetta, Prof. of Chemical Engineering at the University of Texas at Austin, that "becau of the recovery factor of imported crude, the cost would be prohibitive." Further, the purchase of such a large amount of oil involves environmental, political, and economic proble similar to those of oil imports. Storage of imported oil has been discussed in the <u>The Oil Import Question</u>

6. Postpone the Sale - See section VIII. C. of this statemen wherein this alternative is considered. See also FES 72-37, pages 488 and 491.

4. Attachment of Agency Review Comments

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
WASHINGTON, D C 20240

IN REPLY REFER TO:

DES 73-1

MAR 5 1973

Memorandum

To: Director, Bureau of Land Management

From: Director, Bureau of Outdoor Recreation

Subject: Draft Environmental Statement Concerning a Proposed Oil and Gas General Lease Sale Offshore Eastern Texas

This is in reply to your memorandum of January 31, 1973, transmitting the draft environmental statement for the Proposed Oil and Gas Lease Sale Offshore Eastern Texas. We have reviewed the impact statement and offer the following commentary for your consideration. Our review is being presented in the context that it will improve the final state ment as to understanding the impact of the proposed leases on outdoor recreation, general aesthetics, and land use.

Page 24

We suggest that the Impact Sustaining Factors be defined, particularly the factors of beaches and recreation, as they may be the same in certain instances. Further, we urge that footnote 4 be extended to all recreation areas; namely, State, county, and city parks. Additionally we suggest that the description of recreation areas be expanded to include those presented to your Bureau in our memorandum of January 16 1973. A copy of the January memorandum, with attending maps and inventory data, is attached for your convenience.

Resources of the Northwestern Gulf of Mexico and Adjacent Coastal Zone Land Use Patterns

On page 136, it is stated: "Although not shown on the map, there are numerous county and city-owned parks in or near the urban areas." Because of the importance of water-based recreation areas along the coastline of the proposed project area, we suggest that the maps shown on pages 129, 130, 131, 133, 134, 135, 137, 138, and 139 be appropriat amended to show all existing recreation areas listed in the above mentioned inventories; i.e., those discussed in the draft statement as well as those listed in the attached January 16, 1973, memorandum. Further, we urge that maps similar to those shown in the report, Natio Shoreline Study, Texas Coast Shores Regional Inventory Report, prepare

by the Corps of Engineers, Galveston, Texas, be used in the final environmental statement. Examples of the maps include those showing:

- o Beaches and areas of erosion; critical erosion, non-critical erosion, and beach zone.
- o Land ownership and use; Federal, non-Federal public, public recreational, private recreational, non-recreational development.

We find that the maps in the Corps of Engineers' report have more detail than those in the draft environmental statement; particularly for the Galveston area tracts discussed on pages 343, 344, and 345. In addition, we suggest that the final environmental statement would be greatly improved if photographs, such as those shown on pages 7, 8, 11, 12, 15, 16, etc., of the Corps of Engineers' report, were used to show the different kinds of beaches and land uses along the coast and adjacent to the estuaries of the proposed lease area.

A Matrix Analysis of Some Possible Adverse Impacts on the Environment and Related Uses

We believe that the two "Relative Environmental Impact Scale" classes shown and defined on page 264 should be redefined to include at least three to five classes. The two classes shown on page 264, in our view, are not definitive or comprehensive enough to reflect the six classes of "Scale of Importance" and six classes of "Proximity Scale" used to determine the final "Relative Environmental Impact Scale."

Further, we do not believe that the use of 0.5 knots, as an average for shoreward ocean current velocities to determine the Proximity Scale (PR) for oil spills, is realistic. The 0.5 knot figure is not reflected in the section on "ocean currents," pages 71 through 74. The only velocity data presented in the section on ocean currents is that for the winter season, ". . . surface currents over the continental shelf are along shore, westerly and southwesterly with velocities ranging from 8 to 13 miles per day." Therefore, we urge that the use of the 0.5 knot figure to determine PR be fully addressed in the final statement.

Our reasoning for the need of further discussion on the use of the 0.5 figure is presented in the following chart for several of the block tracts as discussed on page 343 - section on Oil Spills in the Galveston Area.

Analysis of Possible Adverse Environmental Impact for Several Plots in the Galveston Area. (Coastal Activity - Outdoor Recreation)

	IMPACT FACTORS (1)			IMPACT FACTORS (2)			IMPACT FACTORS (3		
Block No.	IM	PR	F(OS)	IM	PR	F(OS	IM	PR	F(OS)
190 (E 1/2)	80	0.5	40	80	1.0	80	80	0.7	56
211 (N 1/2)	80	0.4	32	80	0.8	64	80	0.6	48
212 (N 1/2)	80	0.5	40	80	1.0	80	80	0.7	56
325	80	0.1	8	80	0.2	16	80	0.14	11

(1) Ocean current velocity assumed to be 0.5 knots.

(2) Ocean current velocity assumed for the winter months to be 8 to 13 knots, or an average of 10.

(3) Ocean current velocity assumed to be an average of 0.5 to 13, or approximately 7 knots.

From the above analysis, it can be readily seen that when we use the ave figure of 10 knots for the winter months, the statement on page 332 unde paragraph 6. Outdoor Recreation, may not be valid, that is: "There are tracts in this proposed sale which reflect an environmental impact facto of 50 or more under either structure or oil spills for this category." is possible that the above calculations may be in error, however, based upon the information presented in the draft environmental statement. We believe that such a possibility exists and should be addressed in the environmental statement.

Further, we believe that the above analysis supports our position for th need of more than two classes of "Relative Environmental Impact Scale." Such a need is especially necessary for tracts located less than 20-25 m from the coast.

Since it is especially important that the "mood or aesthetic atmosphere" of people utilizing the beaches and other recreation areas along the coa bays, and estuaries of the proposed base area not be excessively disturb we further suggest that the final statement fully address the following:

- The dumping of drill cutting and well sand as it pertains to creating excessive turbidity and being transported by ocean currents to beach and other recreation areas;

- Excessive noise and odor pollution reaching beach and other recreation areas; and

- The locations of the needed pipelines.

We appreciate the opportunity to review and comment on this environmental statement.

Enclosure

for James G. Watt
Director

United States Department of the Interior

OFFICE OF OIL AND GAS
WASHINGTON, D.C. 20240

MAR 5 197

In Reply Refer To:
3300.3 (392)

Memorandum

To: Donald Truesdell, Division of Marine Minerals (392)

From: Acting Director, Office of Oil and Gas

Subject: Draft Environmental Statement Concerning a Proposed Oil Gas General Lease Sale Offshore Eastern Texas

Concerning the subject environmental impact statement, we have no further comment.

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D C. 20242

OFFICE OF THE DIRECTOR

March 7, 1973

DES 73-1

Memorandum

MAR 13 197

To: Donald Truesdell, Division of Marine Minerals
Bureau of Land Management
Through: Deputy Assistant Secretary--Mineral Resources

From: Director, Geological Survey

Subject: Draft Environmental Statement Concerning a Proposed Oil and Gas General Lease Sale Offshore Eastern Texas

We have reviewed the subject draft environmental statement as requested by the Director, Bureau of Land Management, in a memorandum of January 31. Our comments are as follows:

On page 8 is shown a columnar table describing the total impact of the complete 5-year leasing schedule; this table is very specific in terms of acreage, numbers of holes, platform, miles of pipeline, terminals, and other considerations. A somewhat similar summary table for this on sale would be quite useful.

We do not believe the last paragraph on page 183 is either clear or ade quate, and we suggest that the first sentence be deleted and replaced with the following:

> If a blowing well is releasing only natural gas, the possibi ity of ocean pollution is minimal. However, the safety of personnel and the security of the platform or drilling struc ture are imperiled should a fire occur. The decision whethe or not to extinguish a gas fire depends on the circumstances of the moment. For example, it might be advisable to allow a gas well fire to burn while remedial action is being prepared if the structure and personnel are not in jeopardy. T

> would preclude accidental ignition while personnel were in the area of gas accumulation. The overall thrust, however, is quickly extinguishing the fire and bringing the well under control. Whether or not a fire results, a blowing gas well . . .

The first paragraph on page 207 indicates the impacts of setting platforms are the same as those described for the placement of drilling rigs, which was described on page 177, including by reference that sport fishing will be excluded. We believe that studies show that platforms provide ideal sport fishing areas, and suggest appropriate revision of page 207. Also, in that same paragraph, the area denied for trawling operations by a platform should be specifically identified, and compared with the 2 to 5 acre estimate for jack up rigs on page 177.

On pages 229 and 230, in the discussion of the Bay Marchand fire, the conclusion is made that the fire "was ignited as a result of carelessness." In fact, the Geological Survey investigation indicates the situation could more accurately be described by indicating that the resulting fire involved human error but not necessarily carelessness. The workmen did attempt to close the valves, but in fact failed to completely close said valves because of plastic accumulation in the wellhead. The sentence, "The well blew off and the fire ignited," should be omitted as it is technically incorrect. The action that did occur could be described as:

> Plastic, used as a corrosion preventative in the tubing of well B-21, had sloughed off and lodged in the gate of the master valve. As the gate was closed, this plastic compressed, preventing complete closure of the valve, but giving an indication that the valve was closed. The well appeared to be shut-in, but after 30-40 minutes the plastic began to slip through the gate opening and was finally released, thus opening the well to the atmosphere and allowing oil to escape.

It is not a fact that 10 of the other 21 wells on the platform were damaged by the initial explosion. The damage is more properly and accurately explained by indicating that subsequent falling debris and the intense heat of the fire caused serious damage to those 10 wells.

Two additional impacts which might be added to the statement would be effects of subsurface disposal of brines--if this could become expedient in some circumstances--and the possibility of induced subsidence of onshore areas.

Henry W. Coulter
Acting Director

OFFICE OF THE DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON, D C. 20240

In Reply Refer To:
MBM - MRED-MS-DFF

February 16, 1973

Memorandum

To : Donald Truesdell, Division of Marine Minerals, Bureau of Land Management

Through: Deputy Assistant Secretary—Mineral Resources Harry L. Moffett FEB 26 1973

From : Director, Bureau of Mines

Subject: Review of Draft Environmental Statement on Proposed East Texas General Offshore Lease Sale

The draft has been reviewed as requested in a memorandum of January 31 from the Director, Bureau of Land Management, to other Agency Directors.

The Bureau of Mines has provided suggestions for preparation of drafts for previous offshore oil and gas lease sales. Many of these suggestions have been incorporated into the subject draft.

On page 432 of the draft is a discussion of an alternative to the proposed offshore lease sale titled "Increase Onshore Oil and Gas Production." This section points out some of the problems of the low gas-discovery rates and the declining natural gas reserves of the recent past. We believe the section should also include a recognition of the fact that newly discovered reserves and increased productivity do not result in larger deliveries of natural gas to consumers unless facilities and incentives are available to bring about the delivery of the gas. Natural gas supplies and natural gas market areas are highly localized. A gas discovery in Utah, for example, would not offer much relief for energy-short areas in Illinois because transmission facilities to deliver the gas are inadequate.

An advantage of the proposed offshore lease sale over the onshore alternative herein being considered is that transmission facilities already exist which can deliver gas from the vicinity of the proposed offshore lease sale area to major U.S. market areas. Onshore oil and gas lease sales in many areas of the U.S., lacking this facility, would be poor alternatives to the proposed offshore sales.

E. F. Osborn

Director

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D C 20545

FEB 23 1973

Mr. Donald Truesdell
Department of the Interior
Bureau of Land Management
Division of Marine Minerals
Washington, D. C. 20240

Dear Mr. Truesdell:

This is in response to your letter of January 31, 1973 transmittin for review and comment your draft environmental statement concerni a proposed Outer Continental Shelf oil and gas general lease sale consisting of 129 tracts of submerged lands offshore eastern Texas The Increased Nuclear Power alternatives has been adequately treat and we have no further comments to offer regarding that section.

However, several comments follow regarding the Wellbore Stimulatio for Recovery from Known Deposits alternative. Add the following t section b. on p. 530 "increasing to two trillion by the late 1980' and to about three trillion cubic feet by the 1990's." In the fir paragraph of section d. on pp. 530 and 531 change the last three sentences to read as follows: "First, would be the effects of rad activity. Secondly, seismic disturbances resulting from the explosions would have adverse effects. However, atmospheric contamination or disturbance is unlikely." Change the first sentence of the last paragraph on p. 532 as follows: "A schedule which has been analyzed calls for drilling and firing 100 wells per year (for possibly 50 to 60 years)." Change the last sentence of the same paragraph on p. 533 by eliminating "AEC estimates that In the next paragraph on p. 533 change "speculation" to "some uncertanity" and add "for the specific situation and locality" to the second sentence.

FEB 23 1973

In addition some changes are required in the table on p. 581 to more accurately reflect the realistic situation. Under Expl. Fracturing 1980 change 8200 to 2700; 8500 to 2800 and for 1985 change 8200 to 4100 and 3500 to 4200. Under sub note 2/ change to read "assumes ultimate recovery at rate of 1% of ....."

Thank you for the opportunity to review your statement. We trust that these suggested changes will be useful to you in improving the accuracy of the statement. If you have any questions please do not hesitate to contact me.

Sincerely,

Robert J. Catlin

Robert J. Catlin, Director
Division of Environmental Affairs

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D C 20504

OFFICE OF THE DIR

FEB 27 1973

-340

Mr. George L. Turcott
Associate Director
Bureau of Land Management
Department of the Interior
Washington, D. C. 20240

Dear Mr. Turcott:

We have reviewed the draft Environmental Statement for the Proposed 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale, as it relates to the Mandatory Oil Import Program.

I note that the basic comment made by General Lincoln with the advice of the Oil Policy Committee in his letters to Secretary Morton (attached) relative to the draft 1972 East Louisiana lease sale has not been met: namely, that increased imports are not an acceptable alternative to increasing offshore production by this and other sales. In general, the other more detailed suggestions which we made at that time have been incorporated and the text appears to be accurate and well phrased. Attached are the few minor changes that we recommend be made in the present draft.

Sincerely,

Darrell M. Trent

Darrell M. Trent
Acting Director

Attachments

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

OFFICE OF THE DIRECTOR

June 8, 1972

Honorable Rogers C. B. Morton
Secretary of the Interior
Washington, D. C. 20240

Dear Mr. Secretary:

Referring to my letter of May 25, 1972, (copy enclosed), I have consulted the Oil Policy Committee on the matter of the draft Environmental Statement for the Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Eastern Louisiana. The Committee is in agreement with the view in my letter and considers that increased development of domestic resources is essential from a national security point of view; increased imports clearly are not an acceptable alternative to increasing offshore production by this and other sales, which should be expedited.

The Committee also agrees with my conclusion that the issue is not one of either retaining or eliminating the Mandatory Oil Import Program as alternatives, since this program is a flexible one which can be adjusted to allow any level of imports deemed consistent with national security. The real issue, from a national security point of view, is whether a major expansion of imports is an acceptable alternative to the development of the oil and natural gas resources of the outer continental shelf. As stated in the paragraph above, we do not find this to be the case.

Sincerely,

G. A. Lincoln

G. A. Lincoln
Director

Enclosure

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

OFFICE OF THE DIRECTOR

May 25, 1972

COPY

Honorable Rogers C. B. Morton
Secretary of the Interior
Washington, D. C. 20240

Dear Mr. Secretary:

This letter continues the frequent and continuous discussion and exchanges with you, your assistants, and among our staffs on the need to accelerate offshore leasing in order to improve our domestic energy base. I have reviewed generally the draft environmental statement on the proposed 1972 Outer Continental Shelf oil and gas general lease sale offshore Eastern Louisiana. This lease sale is one of the lease actions in the continuing development of our domestic base which we need to expedite for national security, as well as other reasons.

I have noted that there can be some improved precision in the language in the draft, one example being the way we are now managing the Mandatory Oil Import Program in Districts I through IV (see enclosure), and I have asked that my staff continue their consultation with yours on detailed editing suggestions.

Sincerely,

Signed

G. A. Lincoln
Director

Enclosure

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

OFFICE OF THE DIRECTOR

June 8, 1972

Honorable Rogers C. B. Morton
Secretary of the Interior
Washington, D. C. 20240

Dear Mr. Secretary:

Referring to my letter of May 25, 1972, (copy enclosed), I have consulted the Oil Policy Committee on the matter of the draft Environmental Statement for the Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Eastern Louisiana. The Committee is in agreement with the view in my letter and considers that increased development of domestic resources is essential from a national security point of view: increased imports clearly are not an acceptable alternative to increasing offshore production by this and other sales, which should be expedited.

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Sincerely,

G. A. Lincoln

G. A. Lincoln
Director

Enclosure

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

OFFICE OF THE DIR

May 25, 1972

COPY

Honorable Rogers C. B. Morton
Secretary of the Interior
Washington, D. C. 20240

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I have noted that there can be some improved precision in the language in the draft, one example being the way we are now managing the Mandatory Oil Import Program in Districts I through IV (see enclosure), and I have asked that my staff continue their consultation with yours on detailed editing suggestions.

Sincerely,

Signed

G. A. Lincoln
Director

Enclosure

SUGGESTED CHANGES IN DRAFT ENVIRONMENTAL STATEMENT RE OCS LEASE SALE

P. 407, line 3 - The OPC as well as the OPC Working Group were consulted.

P. 408, line 6 - The word "design" should be "designed."

P. 413, line 4 - "During September 30" should read "ending September 30."

P. 420, line 17 - "A five-year agreement between oil companies and Persian Gulf countries, reached in 1971 . . ."

P. 425, line 12 - The words "national gas" should be "natural gas."

P. 427, line 2 - "substitution of oil for gas" rather than "oil and gas."

We have assumed that the cut-off date of the end of 1972, implicit in the draft text, will continue to stand and have therefore not suggested insertion of the changes in the MOIP and in OEP responsibilities made in 1973. If this is not the case, changes are needed on P. 411, line 15 (OPC chairman), and on P. 415 (January 1973 Proclamation).

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

L7619-OCC

MAR 12 1973

Memorandum

To: Director, Bureau of Land Management
Attn: Donald Truesdell, Division of Marine Minerals

Through: Assistant Secretary for Fish and Wildlife and Parks

From: Assistant Director, Park Management

Subject: Draft environmental statement concerning a proposed oil and gas general lease sale offshore eastern Texas (DES 7

We are pleased to furnish you our comments on the subject draft environmental statement in accordance with your memorandum of Janu

Comment on the Proposed Action: It appears that the proposed acti would not directly affect any inland existing or proposed units of National Park System, nor any site eligible for registration as a National Historic, Natural, or Environmental Education Landmark. ever, the proposed action, by way of increasing the possibility of spills, could adversely affect areas of the National Park System, existing or proposed and National Landmarks as well, in and along Gulf of Mexico.

Comments on the Draft Environmental Statement: We were heartened on page 146 that the Bureau's New Orleans-based Environmental Asse Team is locating, describing and inventorying archeological and hi sites on the OCS. Although, the text does not so indicate, we tru that professional archeologists and historians will participate on Team. We suggest that when the Team undertakes location, descript and inventory of cultural resources on the OCS, it focus its atter upon deltas and valleys of submerged former rivers and upon former lines. These are the places where early people would have lived w the OCS was dry land some 4,000 - 25,000 years ago, and, consequer are the places where cultural resources are most likely to occur.

ADDRESS O
BUREAU OI
AND WILDLI

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
WASHINGTON, D C 20240

MAR 3 0 1973

Memorandum

To: Director, Bureau of Land Management
Attention: Code 392

From: Deputy Director, Bureau of Sport Fisheries and Wildlife

Subject: Review of Draft Environmental Statement Pertaining to a Proposed Oil and Gas General Lease Sale Offshore Eastern Texas

In response to your request of January 31, 1973, we have reviewed the subject draft statement and offer the following comments.

We feel that the draft statement presents a thorough description of the proposed project, the existing environment and the potential impact of the project on the economy and the natural resources in the sale area.

We are concerned, however, with certain aspects of this proposed sale and with others which have preceded it. Our concern is centered arou the apparent break down of administrative control over the constructi of pipelines which will result directly from each OCS lease sale. Fc instance, we note that the petroleum industry estimates a requirement for three new major pipelines for transporting hydrocarbon production from this proposed sale area to shoreside facilities and refineries. Yet, decisions affecting pipeline construction are not made for some time after the lease sale has been approved. We understand that authority for granting permits for pipeline construction and rights-of-way is shared by several different agencies, including this Bureau responsibility under the Fish and Wildlife Coordination Act to commer on the U.S. Army Corps of Engineers permit applications for pipeline in navigable waters.

We feel that this approach is not sufficiently structured to provide the best protection to our coastal resources, nor to insure proper consideration for other uses of the marine and coastal environment. It is clear that the specific routing of oil and gas pipelines is predicated to a great extent on economic considerations but we feel

that a proper balance of environmental considerations must also enter into the decision. The present system of having industry members seek permits from several different agencies for an indeterminate number of pipelines long after a lease sale has been considered and approved appears to constitute a separate and significant Federal action requiring a more thorough environmental analysis. One mechanism for accomplishing this analysis may well be an environmental impact statement covering individual or groupings of major oil or gas trunk lines which emanate from a certain OCS reservoir or result from a specific lease sale.

This practice would insure a more complete evaluation of any impacts a pipeline may create throughout its course, from platform to high water mark. It would permit full consideration of the feasibility of laying new pipelines in existing corridors or of establishing pipeline corridors in new OCS sale areas. An added benefit would be to focus attention on certain assumptions regarding pipeline construction. For example, the current practice of not backfilling submerged pipelines which require burial under present OCS procedures may not be a safe practice. It is assumed that the lines are ultimately buried by natural forces. This may well be true in areas of active sediment deposition, but can the same be said of erosional areas of the shelf? Even a short run of exposed pipeline is subject to rupture either by an anchored vessel or a grounded vessel, not to mention the problems that may be presented to trawling nets towed by commercial fishing vessels.

We realize that some studies are currently underway concerning OCS pipelines and we agree that much information is needed. However, we feel that the preparation of an environmental impact statement on groupings of pipelines, as suggested earlier, would serve to bring all of the available information together on each pipeline proposal for a more thorough assessment.

Our other comments on this statement involving either typographical errors or other minor considerations have been forwarded directly to Code 392.

W. Schmidt

THE ASSISTANT SECRETARY OF COI
Washington, D C 20230

March 9, 1973

Mr. Donald Truesdell
Department of the Interior
Bureau of Land Management
Division of Marine Minerals(392)
Washington, D. C. 20240

Dear Mr. Truesdell:

The draft environmental impact statement for 1973 Outer Continental Shelf, East Texas, General, Oil and Gas Lease Sale, which accompanied your letter of January 31, 1973, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

Page 110. In the section on Description of the Environment Figure 18, "Distribution of Bay-Margin Vegetation," create the erroneous impression that no intertidal marshes of *Spartina*, etc., exist in East Bay, West Bay and Lower Galveston Bay.

Page 116. Sub-section 2 concerning The Continental Shelf and Neritic Waters could be made more complete by includin some of the information presented on shrimp larvae by Templ and Fischer (1968); bottom sediment and summer shrimp harve relationships by Grady (1971); non-commercial shrimp specie by Brusher, Renfro and Neal (1972); and demersal finfishes Moore, Brusher and Trent (1970). Three of these publicati have figures portraying levels of catch-effort by isopleth most or all of the OCS region included in this proposed le sale.

Page 126. Sub-section 3, The Oceanic Region - The Deep Gulf, should have added into the discussion of coral reefs the observation that a smaller coral reef reportedly located at approximately latitude 28° 10'N, longitude 94° 18'W apparently supports diverse tropical flora and fauna like that found on the West and East Flower Gardens. This observation was reported in 1965 by collectors for a marine aquarium who collected, among other species, the first Black triggerfishes or Durgons recorded north of the Tortugas (Moore, 1967). This reef is apparently located in parts of tracts A 502 and A 513, High Island Area South Addition, two tracts under consideration for possible leasing. It should also be noted that this reef is charted as an abrupt, distinct mound on the sea bottom in National Ocean Survey (formerly Coast and Geodetic Survey) charts 1116A and 1117A.

Page 164. Two additional references are suggested:

1. American Meteorological Society

   - Cooperative Investigation of the Caribbean and Adjacent Regions (CICAR), Volume 1, Bibliography on Meteorology, Climatology, and Physical/Chemical Oceanography, Washington, D. C., 1970.

2. U. S. Department of Commerce, NOAA/EDS.

   - CICAR Bibliography, Volume II, Marine Biology, Rockville, Maryland, August 1972.

   - CICAR Bibliography, Volume III, Marine Geology and Geophysics, Rockville, Maryland, August 1972.

Page 200. In sub-section c. Blowouts, the discussion under section (d) Impact on Marshes cites Oppenheimer and Gordon (1972) (who are not listed in the Bibliography) as noting that high sand dunes, some as high as 40 feet, would make the estuarine marshes inaccessible to offshore oil

spills. Obviously, these authors were not referring to the East Texas-Western Louisiana shoreline, which is genera low-lying. However, the shoreline would still normally pro vide a sufficient barrier to spilled oil, except at the tidal passes.

Page 206. With regard to the Environmental Impact of the Proposed Sale, sub-section B. Exploration and Construction Phase should discuss the impact of placing exploration and permanent platforms and of constructing pipelines on or next to live coral reefs, if such actions are contemplated. Also, if contemplated, the impact of these activities on grouper or snapper banks should be discussed, including the effects on both the fishery resource and the sport and commercial fishing activities.

Page 207. In the sub-section on 3. Construction of Perman Platforms and Pipelines, most of the discussion under (4) Impact of Fabricating and Laying Pipelines Across Coastal Zone Waters: Bays and Estuaries, is based on two publicati (Ingle, 1952, and Cronin, 1970) that describe several of th potentially deleterious physical effects of dredging as min mal or of short duration. It should also be noted that man studies, including several in the Texas-Louisiana region, have noted significant environmental effects from dredging in shallow waters.

For example, in a study in Louisiana, Mackin (1961) reporte that silt was carried from a spoil island a maximum of 1,30 feet. Breuer (1952) noted in the lower Laguna Madre, Texas that many oysters were killed, and that a bay was partially closed by spoil running off emergent banks. Gunter et al (1964) noted effects from spoil as far as 1,000 feet away from the point of disposal in the upper Chesapeake Bay.

In addition to the study by Breuer (1952), several other examples of spoil damage to shallow waters in Texas are noteworthy. Odum (1963) and Copeland and Dickens (1969) observed that the most severe damage to the biota occurred where spoil was deposited in water less than 0.5 meter deep. Dodgen and Baughman (1949) and Hellier and Kornicker (1962) noted severe damage to submerged grass beds caused by dredge spoil (as far as one-half mile away in the latter study).

Certain studies have indicated that the softer sediments or the increased suspended matter associated with dredging may be deleterious to some benthos. The softer sediments caused by dredging in Tampa Bay, Florida, supported fewer mollusks than the firmer, coarser, undredged substrate (Sykes and Hall, 1970). Brehmer (1965) noted that the feeding activity of benthic organisms can be inhibited by high levels of suspended solids.

Page 250. In order to reduce the possibility of ships colliding with the platforms to the shipping fairways, consideration should be given to improving the lighting, and its reliability, of the structures close to the shipping lanes.

Page 262. Although we have not had the opportunity to thoroughly review the section on Matrix Analysis of Some Possible Adverse Impacts on the Environment and Related Uses, we note that footnote (1) under heading Proximity Scale (Structures), specifies that "Each proposed tract not located in an intensive commercial fishing area has been assigned a value of 0.4." Thus, for tracts located beyond the 100-ft. depth contour, a commercial fishery value of 0.4 has been assigned, whereas those tracts located closer to shore have been assigned a value of 1.0. The publication "Current Fishery Statistics No. 5721, Gulf Coast Shrimp Data, Annual Summary 1970," published in 1971 by the Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, indicates that most of the tracts in the general area of the lease sale are located in NMFS shrimp fishing grid zones 17 and 18. Catch statistics for zones 17 and 18 indicate that commercial fishing for brown shrimp is intensive out to a depth of 35 fathoms (210 ft). Even though the intensive commercial fishery in this area is for only one species, it would seem as though the area of this intensive fishery should be given appropriate emphasis in the matrix analysis. Perhaps a new category intermediate between 0.4 and 1.0 (e.g., 0.7) should be used to recognize the importance of an intensive single-species fishery such as the one for brown shrimp that extends out to at least the 200-ft. contour.

Page 347. This paragraph on waste disposal should be more explicit concerning the requirements for disposal of waste water and other waste materials. Such requirements should conform to all applicable requirements under State and Federal law.

Page 363. With regard to the secton on Mitigating Measures Included in the Proposed Action, sub-section B. Structures would be environmentally strengthened if it were to indicat that exploration or construction would not take place eithe within one mile of any live coral reef or on any grouper or snapper bank currently utilized by sport or commercial fish men. Furthermore, the lease stipulation concerning keeping the number of structures to the minimum necessary, etc., would provide much greater mitigation of losses to commerci fishing if the stipulation also applied to the South Additi and Extension, because, as noted previously in the draft environmental impact statement, about one-fourth of the bro shrimp harvested during 1970 in Texas came from waters betw 126 and 360 feet deep. This sub-section should also acknow the Coast Guard requirement that buoys be placed over protr ing underwater completions. Even greater mitigation of the impact on the commercial trawl fishery would be evident if could also be indicated that these buoys must be lighted an regularly maintained.

Page 369. The mitigation of adverse effects, discussed in sub-section C. Pipelines could be increased if it were stated that pipelines usually would be routed around curren fished snapper or grouper banks. Also, mitigation to commercial trawl fishing would be greatly increased if it were indicated that all unburied offshore pipelines would be marked with regularly maintained lighted navigational aids, such as buoys and ranges, one or more of which would be visible from any location along the exposed pipeline.

Page 370. In the listing of "Agencies having responsibilit or jurisdiction over all or part of oil and gas pipeline installation or operation in coastal areas," the following should be added: "(7) Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service - protection of marine fishery resources

and their habitat (in coordination with the Bureau of Sport Fisheries and Wildlife and the Texas Parks and Wildlife Department or the Louisiana Wild Life and Fisheries Commission), through consultation with the Corps of Engineers in the process of issuing Federal permits in navigable waters."

Page 370. In this same section, it is stated that "At present, the cooperative effort between the Department of the Interior and the Corps of Engineers and State Conservation agencies is responsible for minimizing the impact of pipeline (and other) construction in navigable waters of the United States." The National Oceanic and Atmospheric Administration should also be listed in the cooperative effort (through its National Marine Fisheries Service) since under Reorganization Plan No. 4 of 1970 and related laws, NOAA is vested with a major responsibility for, among other things, participation in matters relating to the marine and estuarine area.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

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ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

March 19, 1973

OFFICE OF THE
REGIONAL ADMINISTRATOR

Mr. Burton W. Silcock, Director
Bureau of Land Management
Washington, D. C. 20240

Re: 06-3-89-TX

Attn: Mr. Donald Truesdell

Dear Mr. Silcock:

We have reviewed the Draft Environmental Impact Statement prepared by your staff for the Proposed 1973 Outer Continental Shelf, East Texas, General Oil and Gas Lease Sale. The proposed sale consists of 129 tracts located in the Gulf of Mexico offsho from approximately Galveston, Texas, east to Cameron, Louisiana. The area consists of 697,643 acres, of which 672,643 are off the shore of Texas and 25,000 are off the shore of Louisiana. The area is approximately 190 miles long with tracts ranging to 120 miles from shore. Of the 129 tracts, 9 are expected to produce oil or oil and gas, with the remaining 120 gas producers

Your agency and, in particular, the staff members who developed this report are to be commended. In general, this statement demonstrates a meaningful analysis of the environmenta consequences of the proposed sale. The following items are suggested for your consideration in developing the final stateme

1. Item B.2, Exploratory Drilling, page 176, discusses the use of "jack-up" type drilling rigs in shallow waters (less than 30 feet deep) while deeper waters require the use of semi-submersible or floating rigs. What is the maximum water depth that platform rigs can be safely used? Further discussion of th subject would strengthen the report. Also, we suggest that consideration be given to including water depths and bottom stability as factors in the matrix analysis for areas utilizing stationary or platform rigs.

2. The continuing paragraph at the top of page 222 discusses the use of various types of structures to minimize salt water intrusion or circulation changes resulting from pipeline installation in open canals. A recent survey revealed that many of these structures were in poor condition. A discussion as to what agency(ies) has jurisdiction over these structures would strengthen the statement. Although these structures may not be the direct responsibility of the Department of the Interior, they are an indirect impact of offshore lease sales; therefore, we suggest the Department of the Interior encourage and promote frequent inspections and necessary maintenance.

3. Item C(1), Production Well Drilling, page 224, states that "After drilling of all wells is completed on a given platform, the drilling mud, or part of it may be discarded into the ocean." With the passage of Public Law 92-532, "Marine Protection, Research, and Sanctuaries Act of 1972," certain limitations and constraints have been placed on ocean dumping. The final statement and the subsequent lease sale offer must reflect the guidelines that are required by this law. EPA will publish interim guidelines in the near future.

4. Item (2), Toxic Chemicals Used in Production Operation, discusses the use of polychlorinated biphenyls (PCB's) in heat-exchangers for breaking down oil/water emulsions. We recommend that, due to the hazardous nature of PCB's, stipulations be placed on this lease sale which would prohibit the use of heat-exchangers which utilize them.

5. Item D, Termination of Oil and Gas Operations, discusses the clean-up procedures and platform removal following termination of operations. We also suggest that consideration be given to requiring the removal of all unneeded pipelines.

6. In our examination of this draft statement, we did not find any indication that the issue of bottom subsidence has been addressed. Subsidence is a problem in the Houston-Beaumont areas of Texas. What measures will be taken to deal with any sinking of bottom contours as a result of oil or gas extraction?

7. The continuing paragraph at the top of page 261 discusses the risk associated with an oil producing tract in the proximity of wildlife refuges, nursery areas, marshlands or heavy commercial

fishing areas. The risk factor has been calculated by multiplyi the nautical miles between the tract and the area by a current velocity of 0.5 knots. We have information from the Naval-Oceanographic Office that indicates this current velocity may be in the 0.7 to 0.9 knot range. Therefore, we recommend that this risk factor be recalculated and re-evaluated to reflect incorpor tion of this current velocity data, or this data be presented as a "range" that could be expected to occur.

8. Item b, Operator Inspection and Testing, page 346, stat that the operating requirements of OCS Orders stipulate "frequer inspection of unmanned facilities. We believe that a definitior for the term "frequent" would strengthen the statement.

9. Item e, Waste Disposal, page 347, states that any lease will be operating in accordance with OCS Order Number 8, which limits oil in brine discharges to 50 ppm. EPA does not believe that this reflects the best treatment technology presently available. We are currently recommending that oil in brine discharges not exceed 25 ppm for offshore activities within the three mile limit, or 10 ppm for activities in brackish or saline waters. Therefore, a brine concentration of 50 ppm average oil discharge into the Gulf can be considered excessive. Public Law 92-500 specifies the goal of providing "best practicable" contro technology by 1977 and "best available" technology by 1983. Discharges resulting from offshore drilling operations will be required by law to be treated to a degree that will reflect consideration of this goal.

10. In conclusion, because of the severe and extensive im that could result from an oil spill, the nine tracts identified oil and gas production should be heavily scrutinized prior to tl inclusion in this lease sale. We also feel that leases should include language to assure abatement and control of air and wate pollution during development, production and abandonment stages It might be well to include copies of sample leases in the fina statement to highlight typical environmental clauses and stipulations.

These comments classify your Draft Environmental Impact Statement as LO-2. The classification and the date of our comments will be published in the Federal Register in accordanc with our responsibility to inform the public of our views on

proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

If you have any questions concerning our categorization procedures, please let us know.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement when it is available.

Sincerely yours,

Arthur W. Busch
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed actic

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of it: potentially harmful effect on the environment. Furthermore, the Agen believes that the potential safeguards which might be utilized may no adequately protect the environment from hazards arising from this act The Agency recommends that alternatives to the action be analyzed fur (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental im of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agen is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately asse the environmental impact of the proposed project or action, or that t statement inadequately analyzes reasonably available alternatives. T Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revisi be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS
U S COAST GUARD (G
400 SEVENTH STREET S
WASHINGTON, D C 205
PHONE 202 426-2

28 MAR 1973

Mr. Donald Truesdell
Department of the Interior
Bureau of Land Management
Division of Marine Minerals (392)
Washington, D. C. 20240

Dear Mr. Truesdell:

This is in response to Mr. Turcott's letter of 31 January 1973 addressed to Mr. Herbert F. DiSimone, Assistant Secretary for Environment and Urban Systems, concerning a draft environmental impact statement for a proposed Outer Continental Shelf oil and gas general lease sale, offshore eastern Texa

The concerned operating administrations and staff of the Department of Tran portation have reviewed the draft statement and we have no comments to offe

The U. S. Coast Guard responded directly to you and suggested that those tracts with a high relative environmental impact factor be considered for removal from the lease sale. This Department concurs with the suggestion of the Coast Guard and the final statement should indicate which of the tracks were removed from the lease sale for this reason.

The Department of Transportation has no objection to the proposed gas and oil general lease sale and appreciates the opportunity to review and comment upon the draft statement. We would be pleased to receive three copies of the final environmental impact statement.

Sincerely,

DMh Binkerd

EXECUTIVE DEPARTMENT

DIVISION OF PLANNING COORDINATION

DOLPH BRISCOE
GOVERNOR

BOX 12428, CAPITOL STATION
AUSTIN, TEXAS 78711
PHONE 512 475-2427

March 5, 1973

Mr. Donald P. Truesdell
Chief
Branch of Environmental Analysis
Division of Marine Minerals
Bureau of Land Management
U. S. Department of Interior
Washington, D. C. 20240

Dear Mr. Truesdell:

The Office of the Governor, Division of Planning Coordination (the S Planning and Development Clearinghouse), and other interested or af Texas State agencies have reviewed the draft environmental impact st ment concerning a Proposed Outer Continental Shelf Oil and Gas Gene Lease Sale of 129 tracts of submerged lands offshore, Eastern Texas

The Texas Parks and Wildlife Department (TP&WD) offers the followin comments:

1. On Page 204, under Section d (ii), the procedure of leavin underwater well completion is described along with the stateme that Coast Guard regulations require that the stub be marked b floating surface buoy. The report continues that these buoys frequently destroyed and fishermen lose valuable trawls on the underwater snag. Because of the difficulty in marking underwa completions, more substantial, lighted buoys should be used or underwater completions should be permitted. It should also be obligation of the company to regularly check to be sure the bu on location and functioning properly.

2. Page 207, 3b, fabrication and laying of pipelines describe procedures for burying pipelines under the floor of the Gulf t depths up to 200 feet. Beyond this depth, pipelines are unbur and would constitute a serious threat to trawl operations. Th important and heavily fished brown shrimp grounds extend beyon 200 feet off the Texas Coast. Unburied lines beyond 200 feet should be marked with lighted buoys or range lights.

3. No drilling location should be established adjacent to the natural coral banks located in the vicinity of some of the proposed lease areas.

A copy of this State agency's comments is enclosed.

Thank you for the opportunity to review this draft environmental impact statement.

Sincerely,

Walter G. Tibbitts III

Walter G. Tibbitts III
Acting Director

WGT:jab

Enclosure (1)

cc: Mr. Clayton Garrison, TP&WD

TEXAS
PARKS AND WILDLIFE DEPARTMENT

COMMISSIONERS
JACK R STONE
CHAIRMAN WELLS
MAX L THOMAS
VICE-CHAIRMAN DALLAS
HARRY JERSIG
SAN ANTONIO

CLAYTON T GARRISON
EXECUTIVE DIRECTOR
JOHN H REAGAN BUILDING
AUSTIN, TEXAS 78701

COMMIS
PEARCE
AUST
BOB BU
TEMP
JOE K
LUBB

RECEIVED
FEB 21 1973
Div. of Plan. Coord.

February 21, 1973

Mr. Harold A. Breard, Jr.
Texas Division of Planning
Coordination
Office of the Governor
Austin, Texas 78712

Dear Mr. Breard:

Reference is made to the Draft Environmental Statement DES 73-1, Proposed 1973 Outer Continental Shelf, East Texas General Oil and Gas Lease Sale, prepared by the Bureau of Land Management.

We have reviewed the draft statement and find that it does an excellent job of covering environmental effects of lease development on the Texas fisheries. There are some items, however, which should be noted.

On Page 204, under Section d (ii), the procedure of leaving an underwater well completion is described along with the statement that Coast Guard regulations require that the stub be marked by a floating surface buoy. The report continues that these buoys are frequently destroyed and fishermen lose valuable trawls on the underwater snag Because of the difficulty in marking underwater completions, more substantial, lighted buoys should be used or no underwater completions should be permitted. It should also be the obligation of the company to regularly check to be sure the buoy is on location and functioning properly.

Page 207, 3b, fabrication and laying of pipelines described procedures for burying pipelines under the floor of the Gulf to depths up to 200 feet. Beyond this depth, pipelines are unburied and would constitute a serious threat to trawl operations. The important and heavily fished brown shrimp grounds extend beyond 200 feet off the Texas Coast. Unburied lines beyond 200 feet should be marked with lighted buoys or range lights.

No drilling location should be established adjacent to the natural coral banks located in the vicinity of some of the proposed lease areas.

Generally, the report is thorough in matters pertaining to the impact on the fisheries; however, the few points listed above we feel are deserving of added emphasis. We appreciate the opportunity to comment on this important project.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:TRL:ga

EXECUTIVE DEPARTMENT
DIVISION OF PLANNING COORDINATION
BOX 12428, CAPITOL STATION
AUSTIN, TEXAS 78711
PHONE 512 475-2427

DOLPH BRISCOE
GOVERNOR

March 8, 1973

Mr. Donald P. Truesdell
Chief
Branch of Environmental Analysis
Division of Marine Minerals
Bureau of Land Management
U. S. Department of Interior
Washington, D. C. 20240

Dear Mr. Truesdell:

On March 5, 1973, we submitted a letter with comments from Texas St agencies on the Proposed Outer Continental Shelf Oil and Gas Genera Lease Sale of 129 tracts of submerged lands offshore, Eastern Texas

Subsequently we received additional comments from the Texas Air Con Board, a copy of which is enclosed. Please place them with our ori letter and enclosures.

Thank you for your cooperation in this matter.

Sincerely,

Walter G. Tibbitts III
Walter G. Tibbitts III
Acting Director

WGT:jab

Enclosure

cc: Mr. Charles R. Barden, TACB

TEXAS AIR CONTROL BOARD

820 East 53rd STREET
AUSTIN, TEXAS – 78751

CHARLES R BARDEN, P E
EXECUTIVE SECRETARY

March 5, 1973

Mr. Ed Grisham, Director
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Ed:

Our agency has reviewed the draft environmental statement on the proposed Outer Continental Shelf oil and gas lease sale. The last paragraph on page 441 oversimplifies the air quality impact of added petroleum production. Ancillary activities such as refining and petrochemical manufacturing will contribute significantly to the reactive hydrocarbon problem and consequently the photochemical smog problem. This aspect should be elaborated and more clearly defined.

We are concerned also about the chronic, low-level oil spillage discussed on Pages 240-241. These small but frequent spills and leaks might account for the substantial levels of hydrocarbons which have been detected in the sea breeze coming off the Gulf. Coupled with this is the high percentage of volatile material in Gulf crude described on Page 187. We found the discrepancy between the mean percent volatility of 44% as determined in the laboratory and the estimate of less than 15% from an actual spill difficult to rationalize.

In brief, the environmental statement has not dealt effectively with the aspect of volatile hydrocarbons from petroleum storage and production. Aside from this, it appears to be reasonably comprehensive and objective. Thank you for the opportunity to evaluate and comment on the subject document.

Sincerely yours,

Charles R. Barden, P.E.
Executive Secretary
Texas Air Control Board

EXECUTIVE DEPARTMENT
DIVISION OF PLANNING COORDINATION
BOX 12428, CAPITOL STATION
AUSTIN, TEXAS 78711
PHONE 512 475-2427

DOLPH BRISCOE
GOVERNOR

March 27, 1973

Mr. Donald P. Truesdell
Chief
Branch of Environmental Analysis
Division of Marine Minerals
Bureau of Land Management
U. S. Department of Interior
Washington, D.C. 20240

Dear Mr. Truesdell:

On March 5, 1973, we submitted a letter with comments from Texas S agencies on the Proposed Outer Continental Shelf Oil and Gas Gener Lease Sale of 129 tracts of submerged lands offshore, Eastern Texa

Subsequently we received additional comments from the Texas Water Development Board, a copy of which is enclosed. Please place then with our original letter and enclosures.

Thank you for your cooperation in this matter.

Sincerely,

Walter G. Tibbitts III
Acting Director

WGT:jab

Enclosure

cc: Mr. Harry P. Burleigh, TWDB

TEXAS WATER DEVELOPMENT BOARD

HARRY P BURLEIGH
EXECUTIVE DIRECTOR

P O BOX 13087
CAPITOL STATION
AUSTIN TEXAS 78711

AREA CODE 512
475-2201

301 WEST 2ND STREET

March 19, 1973

IN REPLY REFER TO

TWDBP-O

Mr. Walter G. Tibbitts, III, Acting Director
Division of Planning Coordination
Office of the Governor
P. O Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Tibbitts:

On February 14, 1973 this Board received from the Division of Planning Coordination a Draft Environmental Statement relative to the 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale. Since the report was to have been forwarded to the Texas Water Quality Board by February 16, our comments were delayed until a copy of the report could be obtained from another source.

This Board has an interest in any development affecting Texas waters. Statutorily, however, we have no jurisdiction over the environmental impact which may result from the pending oil and gas lease sale on the Outer Continental Shelf, since the Texas Water Quality Board, the General Land Office and the Parks and Wildlife Department are the agencies having primary concern in this particular area. Our remarks will, therefore, be generalized.

Over an extended period of time there has been extensive oil and gas exploration in Texas and Louisiana coastal waters that has been a potential source of danger to the coastal environment. We believe that actual damage to the environment from drilling platform accidents has been minimal; probably in no

higher ratio than accidents from land operations. Overall knowledge about deep-water drilling operations has been developed on a world-wide basis far beyond experimental stages, which is to say that the incidence of oil spills and blow-outs will probably be less frequent in the future.

The report very thoroughly reviews the necessity for finding and developing additional sources of fuel to provide the energy needs of the country, and discusses the environmental impact resulting from producing oil and gas, coal, oil from oil shale, and power from nuclear fuels. None of the energy sources are without potential undesirable environmental impacts, but the production and use of natural gas seems to be the least harmful to the total environment.

We are of the opinion that if the nation is to continue on its present basis of power consumption - or even with tolerable reductions - it is essential to find new domestic fuel reserves. The continental shelf oil and gas reserves are fairly well known to exist and can be brought into service more rapidly than other energy sources, such as nuclear power.

We feel that the United States is fortunate in having so readily available a source of clean fuel, the production of which can have little adverse environmental impact if properly controlled. The report shows that almost all devices and principals that have been designed to protect the environment will be employed by the operating companies. Such precautions, coupled with the enormous financial investment by the operating companies, should make for an almost completely safe oil and gas exploration program.

The environmental statement covering the proposed outer continental shelf oil and gas lease sale is probably the most comprehensive report of this nature that we have reviewed, and the opportunity to comment on it is appreciated.

Sincerely,

Harry P. Burleigh

Harry P. Burleigh

George C Wallace
Governor

STATE OF ALABAMA

ALABAMA DEVELOPMENT OFFICE

R C "Red" Bamberg
Director

W M "Bill" Rushton
Assistant Director

February 12, 1973

TO: Mr. Donald Truesdell
Department of the Interior
Bureau of Land Management
Division of Marine Minerals
Washington, D. C. 20240

FROM: Michael R. Amos
State Clearinghouse
Policy Studies Division

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT

Applicant: U. S. Department of the Interior

Project: Draft Environmental Impact Statement for a proposed Outer Continental Shelf Oil and Gas general lease sale

State Clearinghouse Control Number: ADO-08-73

The Draft Environmental Impact Statement for the above project was received by the State Clearinghouse on February 6, 1973.

Please note that this project has been assigned the State Clearinghouse (CH) Control Number shown above. In future correspondence on this project, please refer to the CH Control Number. Your cooperation is appreciated.

This Draft Environmental Impact Statement has been distributed to appropriate State agencies and every effort is being made to ensure prompt action. You will be advised of the comments received.

A-95/04

STATE OF FLORIDA

Department of Administration

Division of State Planning

725 SOUTH BRONOUGH

TALLAHASSEE

32304

(904) 488-2401

Earl M Starnes
STATE PLANNING DIRECTOR

Reubin O'D Asl
GOVERNOR

L K Ireland, .
SECRETARY OF ADMINISTI

March 22, 1973

Mr. Donald Truesdell
U. S. Department of the Interior
Bureau of Land Management
Division of Marine Minerals (392)
Washington, D. C. 20240

Dear Mr. Truesdell:

Functioning as the state planning and development clearinghouse contemplated in U S. Office of Management and Budget Circular A-95, we have reviewed the following draft environmental impact statement.

U. S. Department of the Interior - Bureau of Land Management - Proposed Outer Continental Shelf oil and gas lease sale offshore eastern Texas   SAI Number 73-0852-E

During our review we referred the environmental impact statement to the following agencies, which we identified as interested in the statement Board of Trustees of the Internal Improvement Trust Fund; Game and Fresh Water Fish Commission, Department of Health and Rehabilitative Services - Division of Health, Department of Legal Affairs. Department of Natural Resources, Department of Pollution Control; Department of State - Division of Archives, History and Records Management, and the Environmental Information Center.

Agencies were requested to review the statement and comment on possible effects that actions contemplated could have on matters of their concern. Letters of comment on the statement are enclosed from the Board of Trustees of the Internal Improvement Trust Fund Department of Legal Affairs, and the Department of State - Division of Archives, History and Records Management. The Game and Fresh Water Fish Commission, in a telephone conversation with this agency, recommended that alternative A (page 400) be adopted. The Department of Health and Rehabilitative Services - Division of Health and Department of Natural Resources reported "no adverse comments" by telephone. No responses were received from the Department of Pollution Control or through the Environmental Information Center.

In accordance with the Council on Environmental Quality guidelines concerning statements on proposed federal actions affecting the environment, as required by the National Policy Act of 1969, and U. S. Office of Management and Budget Circular A-95, this letter, with attachments, should be

Mr. Donald Truesdell
Page two
March 22, 1973

appended to the final environmental impact statement on this project. Comments regarding this statement contained in the enclosed letters should be addressed in the statement.

We request to be forwarded one copy of the final environmental statement prepared on this project.

Sincerely,

E. E. Maroney

E. E. Maroney
Bureau of Intergovernmental Relations

EEM/W/dp
Enclosures

cc: Mr. Randolph Hodges
Mr. Joel Kuperberg
Mr. David H. Scott
Mr. William Partington
Mr. Robert L. Shevin
Dr Wade Stephens
Mr. H. E. Wallace
Mr. Robert Williams

ROBERT L SHEVIN
ATTORNEY GENERAL

STATE OF FLORIDA
DEPARTMENT OF LEGAL AFFAIRS
OFFICE OF THE ATTORNEY GENERAL
THE CAPITOL
TALLAHASSEE, FLORIDA 32304

DIVISION OF STATE PLANNING,
Bureau Of
Intergovernmental Relations
MAR 15 1973
RECEIVED
SAI NO. 73-0852-E

March 14, 1973

Mr. Don L. Spicer, Chief
Bureau of Intergovernmental Relations
Department of Administration
Division of State Planning
725 South Bronough Street
Tallahassee, Florida 32304

Re: SAI - 73-0852-E

Dear ~~Mr. Spicer~~ Don:

It is apparent from a review of the Department of the Interior's Draft Environmental Statement on the proposed 1973 Outer Continent Shelf East Texas General Oil and Gas Lease Sale that the Departmen of the Interior is determined to finalize the proposed lease sales despite the adverse environmental effects.

The draft, after explaining the value in productivity of the Gulf Coast area, continues by discussing alternatives and rationalizing why none of the alternatives is acceptable. The Department is apparently willing to trade off one massive form of energy, the food chain, for another.

Considering the fact that the Department is clearly going ahead with the lease sale, it is strongly urged that Alternative A (page 400) be adopted, and that the proposed sale be held "offerin only those tracts determined to have a low potential for environmental harm."

Sincerely,

Bob

ROBERT L. SHEVIN
Attorney General

RLS/Hg

STATE OF FLORIDA
Department of State
THE CAPITOL
TALLAHASSEE 32304

RICHARD (DICK) STONE
SECRETARY OF STATE

DIVISION OF STATE PLANNING
Bureau Of
Intergovernmental Relations
MAR 12 1973
RECEIVED
SAI NO. 73-0852-E

ROBERT WILLIAMS, DIRECTOR
DIVISION OF ARCHIVES, HISTORY, AND
RECORDS MANAGEMENT
(904) 488-1480

March 5, 1973

Mr. Don L. Spicer, Chief
Bureau of Intergovernmental Relations
Division of State Planning
Department of Administration
725 South Bronough
Tallahassee, Florida 32304

Re: SAI #73-0852-E
(Outer Continental Shelf Lease)

Dear Mr. Spicer:

This is to inform you that we have no specific adverse comments to make on this project, due primarily to its location. We would, however, like to make a few general remarks which we feel will reduce the environmental impact relative to archaeological and historical sites. We suggest that a magnetometer survey be conducted along the pipeline routes, and that resultant anomalies be field checked by marine archaeologists. This will prevent destruction of any shipwrecks that might be present in the project area. In addition, there is the possibility that submerged sites will be encountered near the present coastal areas. These should also receive environmental consideration.

Sincerely,

L. Ross Morrell
State Archaeologist & Chief,
Bureau of Historic Sites &
Properties

LRM:Ppmo

STATE OF FLORIDA
BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND
ELLIOT BUILDING — TALLAHASSEE FLORIDA 32304

Joel Kuperberg
Executive Director

TELEPHONE 224 2101

March 16, 1973

Mr. Don L. Spicer, Chief
Bureau of Intergovernmental Relations
Department of Administration
Division of State Planning
725 South Bronough
Tallahassee, Florida 32304

Dear Mr. Spicer:

Draft Environmental Impact Statement on the Proposed 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale. SAI Project Number 73-0852-E.

The Trustees' staff has reviewed the above environmental impact statement and submits the following comments:

The statement appears to be thorough in describing environmental impact and presenting alternatives. However, we feel the problems described below will have tremendous long-term environmental impact and deserve extensive in depth analysis.

In considering both economic and environmental effects on a long-term basis, we are concerned that the tremendous increase in cost, continually dwindling reserves, and increasing environmental risk connected with offshore exploration will approach a balance with the benefits (oil and gas) to be derived from the lease sale.

Nowhere in the statement is an analysis made of the constantly accelerating cost of drilling (especially offshore drilling) compared with the value of the oil and gas produced. In other words, is the cost/benefit ratio (including environmental effects as a cost) still economically advantageous? How much has it changed since the oil industry began in 1859? A projection must be made as to how long it will remain advantageous.

Now that onshore reserves have been "picked over" and have become more costly and difficult to extract, the oil industry is graduating to offshore drilling. A representative of Shell Oil Company stated that onshore drilling operations cost $2000 per day, per well, while offshore operations cost <u>six</u> times as much, averaging $12,000 per day, per well. The oil companies keep reminding us that all the "easy" oil is already found. They state that <u>less</u> oil is to be found, in <u>smaller</u> reserves, and at <u>greater</u> cost of extraction. This inverse ratio between costs and production rates will only worsen as exploration proceeds. This impact statement, since it is dealing with a major shift from onshore to offshore drilling, should attempt to predict how soon the increasing costs will negate the benefits derived from the dwindling reserves.

Concurrent with the increased difficulty and cost of extraction will come a greater risk to the environment. The statement says, "Accidents associated with oil and gas production sooner or later will occur. The long-term effects of oil spills on the marine environment are not clearly understood." An earlier impact statement prepared by the Department of State on the proposed ratification of the International Convention on Civil Liability for Oil Pollution Damage states: "... it is clear that oil pollution represents a serious threat to the marine and coastal environments. By quantity, it is by far the most widespread persistent pollutant of the oceans."

If the oil companies are permitted to continue extraction of fossil fuels for use as an energy source at a constantly accelerating rate, it is inevitable that the reserves will soon be, for all practical purposes, totally exhausted. Some predict total exhaustion within about 85 years. This seems to be a very unwise path to pursue, especially when experts consider the burning of fossil fuels to produce energy as the most wasteful and most destructive use of these vital resources. Their highest use is for lubrication, petrochemicals, plastics, and other similar applications.

To avoid an extreme energy shortage in the future, we must increase the urgency for developing alternate "clean" energy sources now. Presently, the majority of research and development efforts are concentrated on more and faster extraction of a rapidly diminishing supply of oil and gas. We need incentives to bring pressure upon the oil companies so that they will branch out in search of other sources.

If we are ever to solve the energy crisis, we must begin now and face the fact that oil and gas are nonrenewable resources. The most obvious course of action in the matter

of offshore drilling is suggested in the impact statement itself: "A decision to withdraw the sale completely or to seriously limit the number of tracts to be leased would diminish the contribution of OCS petroleum toward meeting future energy demand, and would subsequently necessitate development of alternative sources of energy." (Emphasis added.)

Although minor energy shortages may be caused by withdrawing or severely restricting the sale, limiting national energy consumption can alleviate this problem until alternate sources are developed. The minor shortages we may experience now, can be considered almost negligible when compared with the near disaster that will occur if we continue with present practices.

To recapitulate:

1. As "easy" onshore reserves are exhausted, oil companies are forced to move to more difficult areas such as the north slope of Alaska and the offshore continental shelf of the Gulf of Mexico. This results in tremendous increase in cost with an inevitable decrease in oil and gas production.

2. Along with the increased cost and difficulty of extraction will necessarily come an increased risk to the environment.

3. Total exhaustion of fossil fuel reserves (which is inevitable under present practices) is a self-destructive path to choose. It necessitates a crisis first and then a solution. This can and must be avoided by developing alternate sources of energy before the crisis hits.

4. Alternative B (withdraw or severely limit the sale) may be the only alternative open to us when long-term factors are considered. It will provide the long overdue incentive needed to initiate sincere efforts, on the part of the oil companies, to search for a better, cleaner source of energy.

In short, there must evolve a national energy policy that is truly futuristic in its concepts, not the short-term, politically oriented non-policy of today.

Sincerely,

Joel Kuperberg
Executive Director

S T A T E   C L E A R I N G H O U S E   F O R   F E D E R A L   P R O G R A M S

Federal-State Programs
Office of the Governor
510 Lamar Life Bldg.
Jackson, Mississippi 39201
Telephone 354-7570

State Clearinghouse No.

73020807

Date: February 8, 1973

TO: Mr. George L. Turcott, Associate Director
United States Department of the Interior
Bureau of Land Management
Washington, D. C. 20240

PROJECT DESCRIPTION: Draft Environmental Statement -- DES 73-1 -- Proposed 1973 Outer Continental Shelf East Texas General Oil and Gas Lease Sale consisting of 129 tracts of submerged lands offshore eastern Texas.

(x) 1. The State Clearinghouse has received notification of intent to apply for Federal assistance as described above.

(--) 2. The State Clearinghouse has reviewed the application(s) for Federal assistance described above.

(x) 3. After proper notification, no State agency has expressed an interest in conferring with the applicant(s) or commenting on the proposed project.

(--) 4. The proposed project is ( ) consistent ( ) inconsistent with an applicable State Plan for Mississippi.

(--) 5. Although there is no applicable State Plan for Mississippi, the proposed project appears to be ( ) consistent ( ) inconsistent with present State goals and policies.

COMMENTS: No State agency desires to review this environmental impact statement The distance from the Mississippi Coast is too great to have a significant impact

This notice constitutes FINAL STATE CLEARINGHOUSE REVIEW AND COMMENT. The requirements of U S. Office of Management and Budget Circular No A-95 have been met at the State level

E. C. Mary Jr.

Natural Resources Defense Council, Inc.
1710 N Street, N W
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202 783-5710

March 13, 1973

New York Office
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Burton Silcock
Director,
Bureau of Land Management
Department of the Interior
18th and C Streets, N.W.
Washington, D. C. 20240

Dear Director Silcock:

The Natural Resources Defense Council (NRDC) finds that the Bureau's January 1973 Draft Environmental Statement on the Proposed 1973 OCS East Texas General Oil and Gas Lease Sale differs very little from the Bureau's draft and final environmental statements on the December 1972 OCS lease sale off Louisiana. Hence, NRDC encloses and brings again to the Bureau's attention its comments on those statements, so that the Bureau may take them into account in preparing its Final Environmental Statement for the proposed East Texas lease sale.

Sincerely yours,

Tom Stoel

Thomas B. Stoel, Jr.

TBS/gmm

Enclosures

Comments on the Bureau of Land Management's Final Environmental Statement on the Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Louisiana (October 1972)

Submitted on behalf of:

Natural Resources Defense Council
Sierra Club

Submitted by:

Thomas B. Stoel, Jr.
Edward L. Strohbehn, Jr.
Natural Resources Defense Council
1710 N Street, N.W.
Washington, D. C. 20036

November 22, 1972

I. INTRODUCTION

NRDC and the Sierra Club submitted lengthy comments on the Department's Draft Impact Statement. Some of the deficiencies pointed out in those comments have been remedied; others have not. These comments will discuss briefly some of the inadequacies which persist in this Final Statement.

II. DECISIONMAKING PROCESS

A. In General

The Final Statement still does not contain the kind of detailed analysis of alternatives which would indicate that the Department's consideration of alternatives amounts to more than a *pro forma* ritual. The decision to lease these tracts appears in reality to have been made sometime in the past, and this impact statement seems to be merely a justification rather than playing its intended role as an integral part of the decisionmaking process. This is evidenced by the specific inadequacies noted below and by the Statement's general failure to compare systematically the environmental impacts of alternatives, as required by NEPA.

B. Tract Selection

Our comments on the Draft Statement posed a number of specific questions about tract selection, at pp. 3-5. This Final Statement still leaves almost all these questions unanswered.

III. EVALUATION OF ALTERNATIVES

A. Lease Only Gas-Producing Tracts

The cursory two-page discussion of this alternative indicates that it is not being considered seriously. The legally required detailed discussion of the environmental savings which would result from adoption of the alternative is missing. The Statement does tell how much gas production would be foregone under the alternative, but fails to note that it would amount to only 11.6% of the total production expected from the lease sale.

B. Reduction of Growth in Energy Demand

The discussion of this alternative is longer than in previous Interior impact statements. However, there is still no evidence that the Department has begun or is participating in a decisionmaking process which will result in governmental action to reduce the rate of growth of demand.

C. Modification of FPC Natural Gas Pricing

The four-page discussion of this alternative omits to mention at all the probability that the Administration will prepare early next year the virtual deregulation of natural gas prices. Nor does the Statement mention the econometric studies which will be cited to justify this initiative; in fact, the discussion at p. 376 of the Statement implies that such studies are so unreliable as to be of little value in decisionmaking. The Statement's failure to mention this important and imminent initiative underscores its actual irrelevance to the Department's decisionmaking process and the extent to which that process continues to make a mockery of the National Environmental Policy Act.

D. Increased Oil Imports

A glaring omission is the Statement's failure to discuss storage alternatives which would permit unlimited imports without risk to security. The Department should initiate objective studies of these alternative immediately. The studies should not be entrusted to a self-interested group like the National Petroleum Council or to a biased agency within the Department like the Office of Oil and Gas.

E. Postpone Sale

The one-paragraph discussion of the alternative of postponing the sale pending completion of studies which will provide better understanding of its environmental impact is wholly inadequate. At a minimum, the discussion should list all of these studies, their objectives, their completion dates, and the reduction in environmental impact which might result from postponing the sale until they are completed.

Comments on the Bureau of Land Management's Draft Environmental Statement on the Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Louisiana (July 25, 1972)

Submitted on behalf of:
Natural Resources Defense Council
Sierra Club

Submitted by:
Thomas B. Stoel, Jr.
Edward L. Strohbehn, Jr.
Natural Resources Defense Council
1710 N Street, N.W.
Washington, D.C. 20036

August 29, 1972

I. INTRODUCTION

The Natural Resources Defense Council, Inc. (NRDC) and the Sierra Club find that the Bureau of Land Management's Draft Environmental Statement on the "Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Louisiana" (July 25, 1972) (hereinafter cited as Draft Statement) and the Department of Interior's decisionmaking process with respect to this proposed lease sale do not satisfy the requirements of the National Environmental Policy Act (NEPA).[1] These comments focus on the principal deficiencies. Specifically, the Department has: (1) failed to observe the decisionmaking procedures required by NEPA with respect to consultations with federal, state, and local agencies, and disclosure of information; (2) failed to undertake a careful and comprehensive evaluation of alternatives to the proposed sale and their environmental impacts; and (3) failed to evaluate or evaluated inadequately the potential environmental impacts of the proposed sale.

II. DECISIONMAKING PROCEDURES

The Department has not adequately disclosed information about its decisionmaking processes. The Department also has not disclosed

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1_/ Act of Jan. 1, 1970, 83 Stat. 852, 42 U.S.C. §§ 4321-4347.

what it intends to do to obtain material information which it lacks. Finally, the Department has not complied with the consultation requirements of NEPA.

A. Disclosure of Information

Courts have consistently required strict compliance by federal agencies with the requirements of Section 102 of NEPA,[2] which include the duty to provide the information and analysis supporting the agency's decision:[3]

> "[A federal agency] must not only observe the prescribed procedural requirements and actually take account of the factors specified, but it must also make a sufficiently detailed disclosure so that in the event of a later challenge to the agency's procedure, the courts will not be left to guess whether the requirements of NEPA . . . have been obeyed . . . . To enable a court to ascertain whether there has been a genuine, not a perfunctory compliance with NEPA, the [federal agency] will be required to explicate fully its course of inquiry, its analysis, and its reasoning.[4]

NEPA also requires full disclosure of environmental impact information in the detailed statement.[5] Where important information is lacking, the Department should initiate studies or other measures

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2 / 42 U.S.C. § 4332.

3 / See, e.g., Calvert Cliffs' Coordinating Committee, Inc. v. AEC, 449 F.2d 1109, 2 ERC 1779 (D.C. Cir. 1971).

4 / Ely v. Velde, 451 F.2d 1130, 1138, 3 ERC 1280, 1286 (4th Cir. 1971) (emphasis added). See also, Ex. Ord. No. 11514, § 2(b), 35 Fed. Reg. 4247 (1970), and CEQ Guidelines, §§ 3, 6, 10, 36 Fed. Reg. 7724 (1971).

5 / 42 U.S.C. § 4332(2)(C).

to obtain such information.[6] The Interior Department's continuing failure to comply with these requirements is evident throughout the Draft Statement.[7] One example concerns the tract selection process.

B. Tract Selection

On several occasions NRDC has requested information about the procedure by which the Department selects tracts for sale,[8] but these inquiries remain unanswered. In order to "explicate fully" its decisionmaking process the Department should provide information responsive to the following questions: (1) Was a resources evaluation carried out as provided by 43 C.F.R. § 3301.2? (2) Were nominations received with respect to the tracts as provided by 43 C.F.R. § 3301.3? (3) If so, who made the nominations and which tracts were nominated? (4) Did the Bureau of Land Management (BLM) issue a call for nominations on its own motion? (5) What recommendations on tract selection and lease terms and conditions were made by the Geological Survey to the BLM under 43 C.F.R. § 3301.3? (6) What reports were prepared by BLM and other Federal agencies under 43 C.F.R. § 3301.4, and what were the contents of those reports?

6/ *See* 42 U.S.C. § 4332(2)(D) and (G).

7/ Many such deficiencies will be noted in these comments.

8/ NRDC letters of Oct. 14, 1971 and Feb. 10, 1972 to Bureau of Land Management. These letters are printed as attachments to the Department's Final Environmental Statement on the "Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Eastern Louisiana" (June 20, 1972).

The Draft Statement notes that the Geological Survey "has acquired" seismic data for the Louisiana OCS which will aid in determining the productive potential of tracts (p.35)[9] and that "[d]etailed seismic interpretations for each proposed sale prospect are being prepared by the U.S. Geological Survey to support the economic evaluation of the acreage" (p.36, emphasis added). These statements imply that the Geological Survey's analysis is not complete, yet the tracts have already been selected. The Draft Statement should set forth exactly what information was available to the Department at the time of tract selection. In addition, it should specify the source of the data acquired, whether it included interpretive data and/or raw, unevaluated data, and the date on which the pending Geological Survey analysis is expected to be completed.

In addition to the above mentioned data, the Draft Statement identifies what is apparently a separate set of data:

> "The U.S. Geological Survey is acquiring approximately 4,000 line miles of high resolution geophysical data over acreage on the Louisiana OCS to be offered at the proposed General Lease Sale. This data, when correlated with subsurface information from well logs, will define the shallow structural and sedimentary environments over the surveyed area. Information concerning the near-surface environment will provide identification of any areas of potential shallow hazards [to drilling, platforms, or pipelines] that may require a more refined and detailed review prior to leasing and development." (pp.37-38, emphasis added).

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9 / Page references are to the Draft Statement which is the subject of these comments.

This implies that data which appear to be very useful in assessing the environmental risks associated with development of particular tracts has not yet been acquired, much less analyzed. That environmental risks of geological faults are significant was painfully demonstrated by the Santa Barbara spill which occurred through a fissure in the ocean floor adjacent to a well (p.73). The Department explicitly recognizes that this data should be available "prior to leasing and development", yet tract selection has already occurred and the sale scheduled. Again, there is no indication when such data is expected to be available.

In short, a serious deficiency of the Draft Statement is that it sheds no light whatsoever on the tract selection process. To remedy this deficiency the Department must: (1) describe the tract selection procedure in detail, (2) specify the information which was available when selection was made, (3) identify additional information necessary to arrive at a rational assessment of environmental risks, and (4) indicate what steps have been taken or will be taken to acquire such information. Except for some cryptic comments about data which "is being acquired" or "is being analyzed", the reader of the Draft Statement is left in the dark as to how the Department made the critical tract selection decision and about how the Department intends to remedy serious deficiencies in its information about the area to be leased.

C. Consultation

NEPA procedures require the Department to consult with federal,

state, and local agencies in the preparation of an impact statement.[10] The consultations with the States of Louisiana and Mississippi which are cited in the Draft Statement (p.440) are the consultations of March 7, 1972, which related to the previous lease sale offshore Eastern Louisiana.[11] Apparently, no new consultations have been held even though this sale is significantly larger and the sale area is substantially different, involving environmental effects distinct from those associated with the prior sale.

The Department has neither consulted with, nor solicited comments from, the Louisiana Historical Preservation and Cultural Commission and the Department of Anthropology at Louisiana State University to identify historical and archeological sites which might be affected by oil spills or pipeline placement. These consultations were held for the previous sale, but the wording of the Final Environmental Statement covering that sale indicates that attention was directed only to the "proposed sale area"[12] which did not include most of the area involved in the sale covered by the present Draft Statement.

10/ 42 U.S.C. § 4332(2)(C); Ex. Ord. No. 11514, §§ 2(a), 2(f), 35 Fed. Reg. 4247 (1970); CEQ Guidelines, § 9, 36 Fed. Reg. 7724 (1971).

11/ See, Bureau of Land Management Final Environmental Statement, Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Eastern Louisiana 308 (June 20, 1972) (Hereinafter cited as Offshore Eastern Louisiana Final Statement.).

12/ Id. at 50.

Finally, the deficiencies which NRDC noted in its comments on the Offshore Eastern Louisiana Final Statement of June, 1972, regarding the Department's observance of the consultation process have not been remedied.[13] As in the June 1972 Final Statement, the Draft Statement does not indicate that the Department consulted with other federal, state, and local agencies in preparing the discussion of increased onshore development.[14] Regarding the discussion of increased hydroelectric power, the Department does not indicate that it consulted with the FPC and states that "statistics as of <u>January 1971</u> [concerning potential and development water power capacity were] <u>obtained informally</u> from the FPC." (p.351, emphasis added). No explanation is given for failing to consult formally with the FPC or for failing to obtain recent statistics.

D. <u>Conclusion</u>

In general, the Draft Statement suggests that the Department has attempted to meet NEPA requirements in form only and has not really engaged in the decisionmaking process mandated by NEPA. Thus, the content of the Draft Statement suggests that the Department consulted with other agencies only to obtain factual information and not to obtain policy assistance and advice regarding the merits

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13/ Comments of NRDC submitted to the Department of the Interior on July 14, 1972.

14/ *See* Draft Statement 284-305. Compare with statements in *id.*, at, *e.g.*, 254, 306, 356, 362.

of undertaking the proposed lease sale as compared with its reasonable alternatives. The Draft Statement provides no indication that the Department has made a careful "evaluation of the benefits of the proposed project in light of its environmental risks and . . . comparison of the net balance for the proposed project with the environmental risks presented by alternative courses of action."[15] This is forcefully demonstrated by the inadequate discussion of alternatives to the proposed sale, particularly the cursory treatment given two of the principal alternatives: reducing demand for energy and providing the energy resources available from the proposed lease sale by a combination of alternatives. That the Department has not carefully weighed the environmental risks and benefits of alternative courses of action is also demonstrated by the Department's failure to consider environmental impacts systematically. Thus, the advantages of some alternatives are discussed (e.g., of increased onshore oil and gas production pp.303-06), while those of others are not (e.g., increased imports of oil, natural gas, and petroleum products pp.254-84).

III. EVALUATION OF ALTERNATIVES

The Draft Statement fails to evaluate at all or in sufficient detail the following alternatives to the proposed sale and their

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15/ Natural Resources Defense Council, Inc. v. Morton, 2 ERC 1558, 1561 (D.C. Cir. 1972).

environmental impacts: (1) lease only tracts which will produce gas; (2) reduce energy demand; (3) modify FPC natural gas pricing; (4) postpone the sale; and (5) combine alternatives.

A. Lease Only Gas Producing Tracts

A glaring omission is the failure to consider offering only potential gas-producing tracts for sale and withdrawing from sale those tracts expected to produce oil as well as gas, since oil production involves greater environmental risks. This alternative deserves serious consideration since only 26 of the 135 tracts are expected to produce oil (p.442) and 23 of those tracts are in the South Marsh Island-North Addition area which the Draft Statement identifies as the area with the greatest potential environmental risk[16] (pp.64-65, 205-206).

Neither the energy supply effects of withdrawing these tracts nor the environmental impact of including them was analyzed adequately. In the Offshore Eastern Louisiana Final Statement of June 20, 1972, the Department did consider leasing only gas-producing tracts as an alternative.[17] This alternative was rejected at that time because most of the tracts involved were expected to be oil-producing

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16/ As we discuss in detail *infra*, the index upon which the Department bases this determination is almost worthless. However, based on the general discussion of environmental impacts in this Draft Statement, the South Marsh Island tracts do appear to be those with greatest potential environmental risk.

17/ *Offshore Eastern Louisiana Final Statement* 120.

(65 out of 78 tracts), and withdrawal of those tracts "would significantly reduce the part this . . . sale could play in meeting the Nation's energy needs."[18] However, the sale under consideration is expected to yield 15.5 percent of the oil production and three times the gas production anticipated from the Eastern Louisiana sale. Thus, the impact on national energy needs of withdrawing oil producing tracts in the South Marsh Island-North Addition area would be significantly less. In order to evaluate appropriately the effects on energy supply of withdrawing these potential oil producing tracts, the amount of gas which these tracts are expected to produce must be known. The Draft Statement neither provides such information nor indicates that it will be obtained.

In addition, the Draft Statement has failed to evaluate adequately the environmental impact of including the South Marsh Island-North Addition tracts in this sale. The only "analysis" of these tracts is the conclusory statement that:

> "These tracts lie in a proven area of Miocene oil and gas accumulation that has been exploited safely for many years. Several large structures are being offered for sale along with some drainage tracts which lie adjacent to producing wells." (p.35).

There is no information supplied to support the conclusion that production in this area is "safe". These tracts lie in water from 20 to 52 feet deep (p.444), and the Draft Statement indicates that much commercial fishing occurs in water depths under 60 feet (p.64). However, there is no information on the amount of fishing done in the areas covered by these tracts or on the effects of past production

18/ Id.

in these or similar waters on fishing. There is no information on the scope of the production currently occurring in this area, and the drainage tracts to be offered for sale are not identified.

Rather than compiling information necessary to evaluate rationally the consequences of withdrawing or including the South Marsh Island-North Addition tracts, the Department has completely ignored this alternative. Although the Department's own analysis of potential environmental risks (which has serious deficiencies discussed in detail below) indicates that withdrawal of these tracts should be considered since they were assigned Relative Environmental Index Numbers over 70[19] (pp.132, 205), the Draft Statement suggests only "careful planning . . . to assure . . . minimum conflict with commercial fishing" (p.65) and consideration of unspecified "special stipulations" to avoid environmental hazards (pp.205-206). To ignore completely such a potentially viable alternative flouts the requirements of NEPA.[20]

No consideration is given to withdrawing West Cameron Block 134(E1/2) from sale even though: (1) it is expected to be

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19/ These tracts, plus the West Cameron Block No. 34 tract, are the only tracts to receive such a high index for even one of the "significant resource factors" for which indices were developed. In addition, the relative environmental indices for the other significant resource factors for these tracts are significantly higher than for the other tracts proposed for leasing. Compare data at 134-201.

20/ In particular, 42 U.S.C. § 4332(2)(C) and (D); see Natural Resources Defense Council, Inc. v. Morton, supra, note 15.

oil-producing (p.442); (2) it is in 40 feet of water (p.442) in a zone of heavy commercial fishing activity which yielded twenty percent of the 1970 Louisiana catch (p.202); (3) it is 20 miles from shore (p.442) and near the Rockefeller Wildlife Refuge; and (4) it received an Environmental Index Number of over 70 for one significant resource factor and, as compared with the other tracts proposed for leasing (except for the South Marsh Island group), substantially higher relative environmental indices for the other significant resource factors (pp.134, 202). Only unspecified "special stipulations" are mentioned in passing as a means of dealing with the potential environmental impacts associated with this tract (p.202).

B. Reduction of Demand for Energy

Analysis of this alternative (pp.425-436) is reprinted from the Offshore Eastern Louisiana Final Environmental Statement of June 20, 1972.[21] NRDC has emphasized the importance of this alternative in all of its comments on OCS lease sales since October 1971. The President indicated the problems posed by the nation's increasing demand for energy in his June 4, 1971, Energy Message. And the Energy Policy Staff of the Office of Science and Technology in August, 1970, advocated including external environmental costs in

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21/ Offshore Eastern Louisiana Final Statement 293-304.

the price of all forms of energy, which would tend to reduce energy demand.[22] Yet the Department continues to declare that it cannot assess this alternative adequately because it lacks information and that implementation would be difficult. The Department has not even indicated that it will initiate studies to generate the information necessary to evaluate this alternative properly.

Such recalcitrance ignores the command of NEPA that federal agencies "study, develop, and describe appropriate alternatives to recommended courses of action . . ."[23] This failure is not excused by the fact that it would be necessary for other federal agencies to participate in implementation of the alternative.[24] Therefore, NRDC repeats that it is imperative that the Department now commission studies of the alternative of reducing energy demand, so that detailed information can be developed for use when the Department considers future lease sales and other energy policy decisions.

Since the Department's responsibility regarding energy policy decisionmaking is broad, studies must be undertaken which consider short-, middle-, and long-term reductions in energy demand. Quick

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22/ Energy Policy Staff, Office of Science and Technology, Electric Power and the Environment 48 (Aug. 1970). (Report was prepared by OST staff in cooperation with: Dept. of the Interior, Atomic Energy Commission, Federal Power Commission, Dept. of Health, Education and Welfare, Tennessee Valley Authority, Rural Electrification Administration, Council on Environmental Quality.)

23/ 42 U.S.C. § 4332(2)(D).

24/ See Natural Resources Defense Council, Inc. v. Morton, note 15 supra.

initial studies should be made to compile available information and materials, describe the effects of reducing energy demand to the fullest extent possible under current knowledge, and define problems which should be subjected to more intensive study. More detailed studies should be commissioned which include original research and analysis, especially of longer term problems.

The social impacts of reducing energy demand should be investigated and efforts made to identify methods of reduction which distribute the burdens most equitably among members of our society. Various methods for implementing the policy must be analyzed, from direct regulation of energy production and use to public education to development of mechanisms which would affect demand -- such as taxes, effluent charges, and utility rates. The relative effectiveness of each method should be assessed. The Department should also work with other federal, state, and local agencies in developing a coordinated policy of reducing energy demand in the short term and in obtaining legislation necessary to enable government agencies to implement energy demand reduction methods suggested by the studies.

C. Modification of FPC Natural Gas Pricing

Analysis of this alternative (pp.356-361) is reprinted from the Offshore Eastern Louisiana Final Environmental Statement of June 20, 1972.[25] The Department concludes that this can be considered "only a partial alternative" because there is not adequate

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25/ *Offshore Eastern Louisiana Final Statement* 224-229.

information about the effects of the FPC's recent pricing policy changes on development of gas supplies (p.358). While characterizing this as "only a partial alternative", the Draft Statement never attempts even a conservative estimate of the additional amounts of gas which might be made available. As a consequence, evaluation of this alternative alone or as part of a combination of alternatives (p.438) is not undertaken. Contrary to the requirements of NEPA,[26] the Department has failed to initiate the studies necessary to resolve the uncertainty about how much additional gas would become available as a result of increased prices and/or other potential modifications of FPC policy which would make intelligent evaluation of this alternative possible.

In discussing the environmental impact of this alternative, the Draft Statement notes that "most areas thought to have significant gas reserves are offshore" and, therefore, concludes that modifying FPC pricing to stimulate gas production involves essentially the same risks as the proposed OCS sale since such additional gas production would have to come from the OCS or state-owned submerged lands (p.360). During the course of the litigation in NRDC v. Morton,[27] however, the Department of Interior admitted that sixty percent of

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26/ 42 U.S.C. §§ 4332(2)(C),(D).

27/ Note 15, *supra*.

the undiscovered domestic gas is onshore.[28] Thus, the Department's treatment of modifications in FPC policy as an alternative is inadequate (1) for failing to undertake the studies necessary to evaluate the potential of the alternative, and (2) because the assessment of potential environmental effects of the alternative is based on erroneous information.

D. Postpone the Sale

The cursory one-half page treatment of this alternative (p.439) considers delaying the sale until new technology is available to provide increased environmental protection and rejects that alternative on the grounds that present technology and regulations are adequate and that new developments can be applied as they become available. No consideration is given to the possibility of delaying the sale until the acquisition and analysis of the geological and geophysical data mentioned in Section II.B of these comments is complete. Certainly the Department should have weighed this alternative seriously, especially in light of the potential usefulness of such data in assessing environmental risks (p.37). Instead, the Geological Survey's analyses are only briefly mentioned, and the date on which the analyses are expected to be completed is

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28/ Dept. of Interior, "Addendum" to the Final Impact Statement on the 1971 Proposed OCS Lease Sale Offshore Eastern Louisiana, submitted to the United States District Court for the District of Columbia, Jan. 17, 1972 (Civil Action No. 2397-71), at page 1 of section on Modification of FPC National Gas Pricing Policies.

not specified.

It is equally important to consider whether the sale should be delayed pending completion of studies needed to eliminate major gaps in information about environmental impacts. The Draft Statement should indentify the information needed, indicate the probable time required to complete such studies, and analyze the possibility of delaying the sale pending completion of such studies and meeting interim energy needs by some other means.

E. Combination of Alternatives

The Department's two-page discussion of possible combinations of alternatives remains essentially unchanged from the Offshore Eastern Louisiana Final Environmental Statement[29] and is seriously deficient. An action whose environmental impacts could be avoided by any combination of feasible alternative actions with less adverse environmental effects should not be undertaken, yet the Department has failed to give detailed consideration to potential feasible combinations of alternatives as substitutes for all or part of the proposed sale. No effort has been made to identify the combinations which are feasible and subject them to a detailed analysis of relative costs and benefits. For example, a slight modification in oil import policy accompanied by a change in FPC gas pricing

29/ The figures in the table on p.438 have been adjusted to reflect the fact that different amounts of oil and gas are expected from this sale.

policies[30] might provide the short-term energy resources which would be produced by the proposed lease sale while permitting the Department to develop a long-range energy policy sensitive to environmental considerations. Or the Department could consider combining withdrawal of the oil-producing tracts from sale with minor modifications in oil import policies to substitute for the production from the withdrawn tracts.

IV. ENVIRONMENTAL IMPACTS

Central among NEPA's requirements is a comprehensive and detailed assessment of the environmental impacts of a proposed action.[31] This Draft Statement is seriously deficient in this respect in that: (1) it does not adequately assess the potential impacts of pipelines; (2) it does not rationally and systematically evaluate the impacts which have been identified, and (3) it fails to consider the environmental risks of sediment movement, ocean dumping, and blasting.

A. Pipelines

As a result of the proposed sale three new major pipelines will be required together with gathering systems, spur lines, and

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30/ The Federal Power Commission has recently changed its pricing policies substantially, essentially deregulating the price of new gas sold after April 6, 1972. *See* Statement of Policy Relating to Optional Procedure for Certificating New Producer Sales of Natural Gas, Order No. 455, Dkt. No. R-441 (FPC Aug. 3, 1972) (18 C.F.R. § 2.75).

31/ NEPA, 42 U.S.C. § 4332(2)(C).

extensions of existing lines (p.67). The Department has ignored completely some environmental impacts associated with pipeline construction and operation and has failed to provide the information necessary to assess adequately the environmental impacts of these pipelines. These omissions are inexcusable since an Environmental Statement published by the Corps of Engineers[32] contains a detailed discussion of the effects of pipelines and no fewer than seven separate offices in the Department of Interior (including the Office of the Secretary) submitted written comments on the Corps Statement during 1971.[33]

The Corps Statement notes that little dredging is done in the open Gulf of Mexico as a result of oil production operations and that environmental damage from such dredging operations is believed to be slight although there are no known research studies confirming this.[34] However, dredging is done in shallow water near shore for laying pipelines in connection with offshore oil and gas production.[35]

32/ "Final Environmental Statement, Crude Oil and Natural Gas Production in Navigable Waters Along the Texas Coast", U.S. Army Engineer District, Galveston, Texas (Aug. 9, 1972) (Hereinafter cited "Texas Coast Final Statement").

33/ Id. at ii and A-5 through A-25.

34/ Id. at 31.

35/ Id.

While the Draft Statement notes the existence of some environmental impacts of the proposed pipelines (pp.67-70), no attempt was made to assess the probability or potential severity of such impacts.[36] Furthermore, the Draft Statement completely ignores several significant potential impacts of dredging operations and pipeline operations.

Specifically, the Department failed to consider the following potential impacts of dredging and spoiling operations attendant on laying of pipelines near shore: (1) permanent reduction of marine habitat occurs when shallow bay bottoms or tidal marshes become emergent lands due to spoil deposition; (2) temporary turbidity, though generally of little consequence, may have significant adverse effects in shallow clear water with low circulation; (3) dredging may result in resuspension of toxic heavy metals which have settled in bottom sediments in concentrations high enough to kill marine life and/or render the food chain unsafe for human consumption; (4) dredging of channels and spoil deposition can change the hydrologic characteristics of an area causing changes in water quality and sedimentation rates and patterns which can destroy an otherwise

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36/ The Department has "initiated a study to investigate the extent and character of damage to Louisiana coastal resources from pipeline construction." (p.244) The longer term phase of the study will attempt to develop criteria for protecting bottom and shore line resources. Id. No indication is given, however, of when the study will begin or be completed.

productive benthic habitat; (5) spoil areas can adversely affect commercial and sport fishing by eliminating fishing areas; (6) effects on food production in the area may force some species to migrate (of particular concern are endangered species); (7) pipeline excavations near shore can result in destruction of archeological sites; (8) if spoil banks fail to stabilize, generally because of exposure to severe wave action, turbidity can be a severe problem and persist for years.

In addition, the Draft Statement ignores significant risks associated with the operation of pipelines.

> "A significant potential threat to the estuarine environment involves pipelines. Although these lines are buried, they generally cross high value habitat and may become exposed either through shifting sediments or line vibrations. When exposed in navigable waters, they are subject to damage and possible rupture by ship traffic. Abnormal pressures can also cause line rupture if pressure activated safety valves are not installed. If a line should rupture, a serious pollution incident could occur."[37]

The Draft Statement omits information necessary to assess rationally the environmental impacts associated with the proposed pipelines. Essential information which is omitted includes: (1) the total miles of pipe of various sizes; (2) proposed pipeline routes, noting particularly where they go ashore; (3) the amount of dredging anticipated; (4) identification of environmentally sensitive areas near shore; (5) bottom samples to identify sediment

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37/ Texas Coast Final Statement 33.

containing toxic heavy metals; (6) hydrologic and other characteristics of proposed dredging and spoil deposition sites; (7) the reliability record of pipelines currently in place (e.g., number of leaks per mile of pipe in place, size of leak, etc.); (8) effects of low level leakage in shallow, near-shore waters.

B. Matrix Analysis of Possible Adverse Impacts on the Environment and Related Uses

Prior environmental statements on OCS lease sales have generally failed to discuss environmental impacts systematically using comparable indices. Little information has been provided on the probability or potential seriousness of various impacts, nor were references to other materials containing such information provided. Section III.C of the Draft Statement (pp.120-209) contains a matrix analysis of environmental impacts which is not an adequate substitute for a rational, systematic analysis and discussion of impacts[38] and which is seriously deficient in a number of respects. The deficiencies discussed below are presented in the order in which they occur in the Draft Statement (pp.120-132).

38/ To some extent, the matrix analysis in the draft statement resembles the type of environmental analysis suggested by Geological Survey in its Circular No. 645 entitled "A Procedure for Evaluating Environmental Impact." NRDC and the National Wildlife Federation criticized this approach to environmental impact analysis in impact statements primarily because of its tendency to underevaluate unquantifiable environmental impacts. See letter of NRDC to Russell E. Train, Chairman of the Council on Environmental Quality, dated January 7, 1972, and letter of National Wildlife Federation to Train, dated December 22, 1971.

One important qualification to be noted initially is that the matrix does not analyze the potential environmental impacts from "pipelines, support functions and servicing activities, onshore facilities, transportation facilities, etc. [that] cannot be analyzed on a tract-by-tract basis" (p.122). Thus, many major impacts are not analyzed at all, and the reader is left with only the description of such impacts (pp.63-71), which are themselves inadequate as discussed in detail above.

1. Magnitude of Debris (pp.122-123).

This scale does not represent what it purports to represent, the assignment of values is arbitrary, and the procedure for obtaining a total value is erroneous. First, this scale represents the types of debris which might affect natural resources, not the potential magnitude of such debris. Secondly, each of the types of debris is assigned the same value although no data in the Draft Statement indicate that each of these types is equally destructive or equally likely to occur in similar amounts. Finally, adding the individual types of debris to obtain total magnitude is ridiculous: if one small piece of each of the five types of debris could come into contact with the shore, the total "magnitude" would be assigned the value of 10, but if huge amounts of only one type of debris (e.g., toxic material) could come into contact with the shore, and no other types of debris were likely to occur, the total "magnitude" of the debris factor would be 2.

2. Importance of Debris (p.123).

Assignment of the numbers on this scale appears to be arbitrary.

The scale values are displayed in intervals of two while the duration categories are one week, one month, one year, and five years. This implies that the difference between durations of one month and one year is as important in terms of environmental damage as the difference between durations of one year and five years. No data are presented in the Draft Statement to support such a conclusion. In light of the admissions about the lack of information on long-term environmental effects of pollutants (pp.71-109, especially 109) it is doubtful that such data exist. This scale could just as well be constructed linearly as follows:

0 -- no damage
2 -- trace damage
4 -- one-week duration
6 --
8 -- two-week duration
10 --
12 -- three-week duration
208 -- one-year duration
1040 -- five-year duration

Or, if studies indicated greater environmental damage from effects of long duration, a scale might be constructed as follows:

5 -- six-month duration
10 -- one-year duration
75 -- five-year duration
200 -- ten-year duration

In short, the Draft Statement provides no data on which such a scale could be based, and the assignment of values to duration categories is arbitrary.

3. <u>Magnitude of Structures</u> (p.123).

Values are assigned to categories which represent the number of structures per tract, which is at least arguably related to the

magnitude of impact. The scale, however, is not linear. Tracts with zero through three structures are assigned values of zero through six -- the value is double the number of structures. At the top, the scale flattens out. Tracts with four or five structures are assigned a value of eight, and tracts with over five structures are given a value of ten. This assumes that there are no additional impacts from the addition of structures beyond five. Again, there are no data in the Draft Statement to support such an assumption.

4. Importance of Structures for Shipping and Fishing (p.124).

This scale is arbitrary since: (1) the categories describing the impacts are not objectively defined, and (2) there are no data in the Draft Statement to support the assignment of values to the various categories. There is no definition of what constitutes a "serious", "moderate", "low", or "trace" obstacle to fishing or shipping, and there is no account of how each tract was assigned to one of these categories. Even if these categories were objectively defined, the Draft Statement does not indicate that any studies or data exist based on past experience with the effects of structures on shipping and fishing which would support the construction of a linear scale and the assignment of values to the various categories.

5. Importance of Structures for Other Resources (p.124).

This scale is also subjective and arbitrary and is subject to the same criticism as the scale immediately above. It is impossible to determine how tracts were assigned to categories such as "high", "moderate", "minor", and "little".

6. Magnitude of Oil Spill (p.125).

This scale does not accurately represent the potential magnitude of damage from oil spills, and the assignment of values to the scale is arbitrary. The definition of the categories in terms of the percentage of a spill from a given tract which is expected to reach various parts of the environment does not necessarily reflect the potential damage from oil spills. The definition does not consider the amount of oil which would be expected to be spilled from a given tract (given past experience, probabilities of spills of various sizes, expected production rate, etc.) and the effects of spills of various sizes on various resources. Further, the assignment of values to this scale is not linear. There are no data in the Draft Statement to indicate that the relative values assigned actually reflect the relative amounts (magnitude) of damage from the "percentage deposited" categories.

7. Importance of Oil Spill (p.125).

This scale is the same as that used for "Importance of Debris" (above) and is subject to the same criticism.

8. Probability of Damage from Debris (p.126).

Although damage occurred under previous OCS regulations according to the Draft Statement, the probability of debris causing damage in OCS areas is now said to be low. The conclusion is wholly unsupported. No data on comparative experience under the various regulations appear in the Draft Statement.

9. Probability of Damage from Structures (p.126).

This section discusses the probability that structures will be built but contains no information or analysis on the probability of damage being caused by structures once they are built. Thus, the scale does not represent what it purports to represent.

10. Probability of Damage from Oil Spills (p.127).

Based on the asserted fact that "no persistent environmental damage" has been identified with spills from Gulf of Mexico OCS oil operations, the Draft Statement states that "this analysis assumes that the probability of damage from oil spills in the study areas is relatively low." (p.127) This conclusion is highly questionable; no consideration is given to short-term devastating damage (as distinguished from "persistent environmental damage") or to persistent environmental damage identified with spills occurring outside the Gulf of Mexico. In addition, the Department's own analysis of six available studies of the effects of oil spills (pp.73-108) demonstrate that current knowledge is inadequate. The Draft Statement admits that "sufficient data do not exist to permit the calculation of environmental damage from chronic spills of low magnitude or the possible adverse effect on the aquatic ecosystem from oil that remains in open water" (p.127), states that "detailed studies are urgently needed" to study the "full impact of oil spills resulting from OCS activity", and indicates that the Department "is establishing" a project to conduct such studies (p.108, emphasis added).

11. Scale of Probability (p.128).

The categories are undefined; one does not know whether 50%

probability is considered "high", "medium", or "low". It would not seem necessary to use scale values at all; the estimated probability (e.g., 25%) could itself be used as the scale value. However, the reason the undefined categories are used rather than probability values is apparent from the discussion of the three sections on probability immediately above -- there are no data in the Draft Statement on which to base such probability calculations.

12. Proximity Scale (p.129).

Although the categories are objectively defined, some implicit assumptions are made which are unsupported by data in the Draft Statement. The industry plan on which the Draft Statement relies requires containment and cleanup equipment to be brought into use within twelve hours; however, the amount and kinds of equipment to be supplied within that time are not mentioned. Additional information on the time required actually to contain spills of varying sizes, the response time for varying amounts of equipment necessary for spills of various sizes, etc., should be included. The scale assumes that adequate response can be made for any size spill located at least 25 miles from shore or a significant resource. No data are cited in the Draft Statement to support this assumption.

13. Proximity of Structures to Shipping (p.130).

The categories of the scale are objectively defined but there are no data in the Draft Statement, based on past experience of ship interference by structures at varying distances from shipping lanes, to support the assignment of values to the categories.

14. <u>Relative Environmental Index Number</u> (p.131).

The horizontal additiona and subsequent division of the numbers in the matrix is ridiculous. Not only are most of the scale values arbitrarily assigned (as indicated in discussion above), but the scales are not comparable. This is the equivalent of "adding apples and oranges and dividing to get grapefruits," a process which even grade school children are routinely cautioned to avoid.

15. <u>Scale of Relative Environmental Index Numbers</u> (p.132).

Given all the deficiencies noted above, the numbers at this point have achieved total meaninglessness. However, another level of arbitrariness is added, since there are no data or analyses in the Draft Statement to support the division of this scale into the intervals which have been adopted.

This matrix analysis does not provide the rational and systematic evaluation of environmental impacts contemplated by NEPA. Its glaring deficiencies serve only to highlight that the Department lacks the data necessary to support a rational assessment of environmental risks associated with this and other lease sales and the Department's continuing failure to obtain such information. Instead of systematically identifying the needed information and initiating studies to obtain it, the Department has produced an elaborate set of charts which are so riddled with deficiencies as to be worthless.

C. Overdrilling

Little consideration is given to the environmental impact of overdrilling, nor are the procedures by which the Department intends to prevent overdrilling on these tracts detailed. Both are serious omissions. The information provided with respect to overdrilling is essentially the same as that which appeared in the draft and final statements for the offshore eastern Louisiana lease sale[39] and which NRDC found to be inadequate, as noted in our comments. The Draft Statement asserts that the "Supervisor (GS) has authority to prevent overdrilling in the interests of sound conservation practices" and that, in any event, there is no economic advantage to overdrill so that "it is now unlikely that any lessee would undertake overdrilling a tract."[40] Of concern to NRDC and the public is not industry's private decisionmaking process regarding overdrilling but the methods by which the Department will prevent overdrilling. Merely stating that the Supervisor (GS) has authority to prevent overdrilling begs the question. The Department must discuss the methods by which overdrilling _will_ be prevented and the types of data which the Department has or will obtain to determine whether overdrilling is occurring. Particularly relevant are the Department's tract selection procedures and whether the Regional Supervisor has

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39/ _Offshore Eastern Louisiana Final Statement_ 88-107.

40/ _Id_. at 342-343.

routinely required or will routinely require unitization of oil and gas fields to prevent overdrilling. The fact that the Department continues to conduct "drainage sales" is itself an indication that overdrilling is taking place due to less-than-perfect evaluation of tracts before leasing. NRDC has repeatedly requested information about these matters,[41] but the requests have gone unanswered.

D. Remote Control Safety Valves

In the Offshore Eastern Louisiana Final Statement, the Department noted that the Geological Survey was evaluating the potential of remote or surface controlled subsurface valves which would not be solely dependent on well pressure.[42] The current Draft Statement omits mention of this study or its results. However, the Corps of Engineers continues to consider this an important and effective risk-reducing measure:

> "To reduce the possibility of well malfunction, equipment manufacturers and oil producers are cooperating in an extensive program to develop more reliable surface and subsurface safety valves that may be shut down remotely or automatically in case of fire or sudden loss of pressure. Using valves such as these, the probability of a well becoming uncontrollable is extremely remote, especially if 'fail safe' double-valve assemblies (automatic and manual) are installed below the surface."[43]

41/ NRDC letters of Oct. 14, 1971 and Feb. 10, 1972 to Bureau of Land Management which are printed in the "Attachment of Comments Received Concerning the Draft Environmental Statement" to the Offshore Eastern Louisiana Final Statement.

42/ Offshore Eastern Louisiana Final Statement 103.

43/ Texas Coast Final Statement 7.

Failure to discuss such a promising means for reducing environmental risks is a serious deficiency in the Draft Statement.

E. Other Impacts

Possible environmental hazards from sediment movement are not discussed in this Draft Statement, despite the fact that the Offshore Eastern Louisiana Final Statement noted the possible danger from this source.[44] Although the Geological Survey has not yet acquired or analyzed the data which would aid in the assessment of this danger (p.37), the existence of this potential risk should be noted rather than ignored.

Another potential environmental impact not mentioned is that associated with blasting during exploration. The Draft Statement notes that use of explosives "has been largely discontinued" in marine survey operations (p.36). However, a Corps of Engineers analysis of this problem states:

> "Overburden conditions in the Gulf Coast area generally necessitate use of high explosives for successful penetration and credible evaluation of seismic conditions but other less damaging sonic devices have been developed that may be used in <u>some</u> areas."[45]

The Department should consult with the Corps to determine to what extent explosives are being used or will be needed for exploration

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44/ Offshore Eastern Louisiana Final Statement 83.

45/ "Draft Environmental Statement, Crude Oil and Natural Gas Production and Other Mining Operation in Navigable Waters, Louisiana Coast", U.S. Army Corps of Engineers, New Orleans District, April 6, 1972, p.43.

on the Louisiana OCS. Further, the Draft Statement should specify what steps will be taken to require use of less environmentally damaging methods of exploration.

Natural Resources Defense Council, Inc.

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March 13, 1973

Burton Silcock
Director,
Bureau of Land Management
Department of the Interior
18th and C Streets, N.W.
Washington, D. C. 20240

Dear Director Silcock:

The Natural Resources Defense Council (NRDC) finds that the Bureau's January 1973 Draft Environmental Statement on the Proposed 1973 OCS East Texas General Oil and Gas Lease Sale differs very little from the Bureau's draft and final environmental statements on the December 1972 OCS lease sale off Louisiana. Hence, NRDC encloses and brings again to the Bureau's attention its comments on those statements, so that the Bureau may take them into account in preparing its Final Environmental Statement for the proposed East Texas lease sale.

Sincerely yours,

Tom Stoel

Thomas B. Stoel, Jr.

TBS/gmm

Enclosures

Comments on the Bureau of Land Management's Final Environmental Statement on the Proposed 1972 Outer Continental Shelf Oil and Gas General Lease Sale Offshore Louisiana (October 1972)

<u>Submitted on behalf of:</u>

Natural Resources Defense Council
Sierra Club

<u>Submitted by:</u>

Thomas B. Stoel, Jr.
Edward L. Strohbehn, Jr.
Natural Resources Defense Council
1710 N Street, N.W.
Washington, D. C. 20036

November 22, 1972

I. INTRODUCTION

NRDC and the Sierra Club submitted lengthy comments on the Department's Draft Impact Statement. Some of the deficiencies pointed out in those comments have been remedied; others have not. These comments will discuss briefly some of the inadequacies which persist in this Final Statement.

II. DECISIONMAKING PROCESS

A. In General

The Final Statement still does not contain the kind of detailed analysis of alternatives which would indicate that the Department's consideration of alternatives amounts to more than a *pro forma* ritual. The decision to lease these tracts appears in reality to have been made sometime in the past, and this impact statement seems to be merely a justification rather than playing its intended role as an integral part of the decisionmaking process. This is evidenced by the specific inadequacies noted below and by the Statement's general failure to compare systematically the environmental impacts of alternatives, as required by NEPA.

B. Tract Selection

Our comments on the Draft Statement posed a number of specific questions about tract selection, at pp. 3-5. This Final Statement still leaves almost all these questions unanswered.

III. EVALUATION OF ALTERNATIVES

A. Lease Only Gas-Producing Tracts

The cursory two-page discussion of this alternative indicates that it is not being considered seriously. The legally required detailed discussion of the environmental savings which would result from adoption of the alternative is missing. The Statement does tell how much gas production would be foregone under the alternative, but fails to note that it would amount to only 11.6% of the total production expected from the lease sale.

B. Reduction of Growth in Energy Demand

The discussion of this alternative is longer than in previous Interior impact statements. However, there is still no evidence that the Department has begun or is participating in a decisionmaking process which will result in governmental action to reduce the rate of growth of demand.

C. Modification of FPC Natural Gas Pricing

The four-page discussion of this alternative omits to mention at all the probability that the Administration will prepare early next year the virtual deregulation of natural gas prices. Nor does the Statement mention the econometric studies which will be cited to justify this initiative; in fact, the discussion at p. 376 of the Statement implies that such studies are so unreliable as to be of little value in decisionmaking. The Statement's failure to mention this important and imminent initiative underscores its actual irrelevance to the Department's decisionmaking process and the extent to which that process continues to make a mockery of the National Environmental Policy Act.

D. Increased Oil Imports

A glaring omission is the Statement's failure to discuss storage alternatives which would permit unlimited import without risk to security. The Department should initiate objective studies of these alternative immediately. The studies should not be entrusted to a self-interested group like the National Petroleum Council or to a biased agency within the Department like the Office of Oil and Gas.

E. Postpone Sale

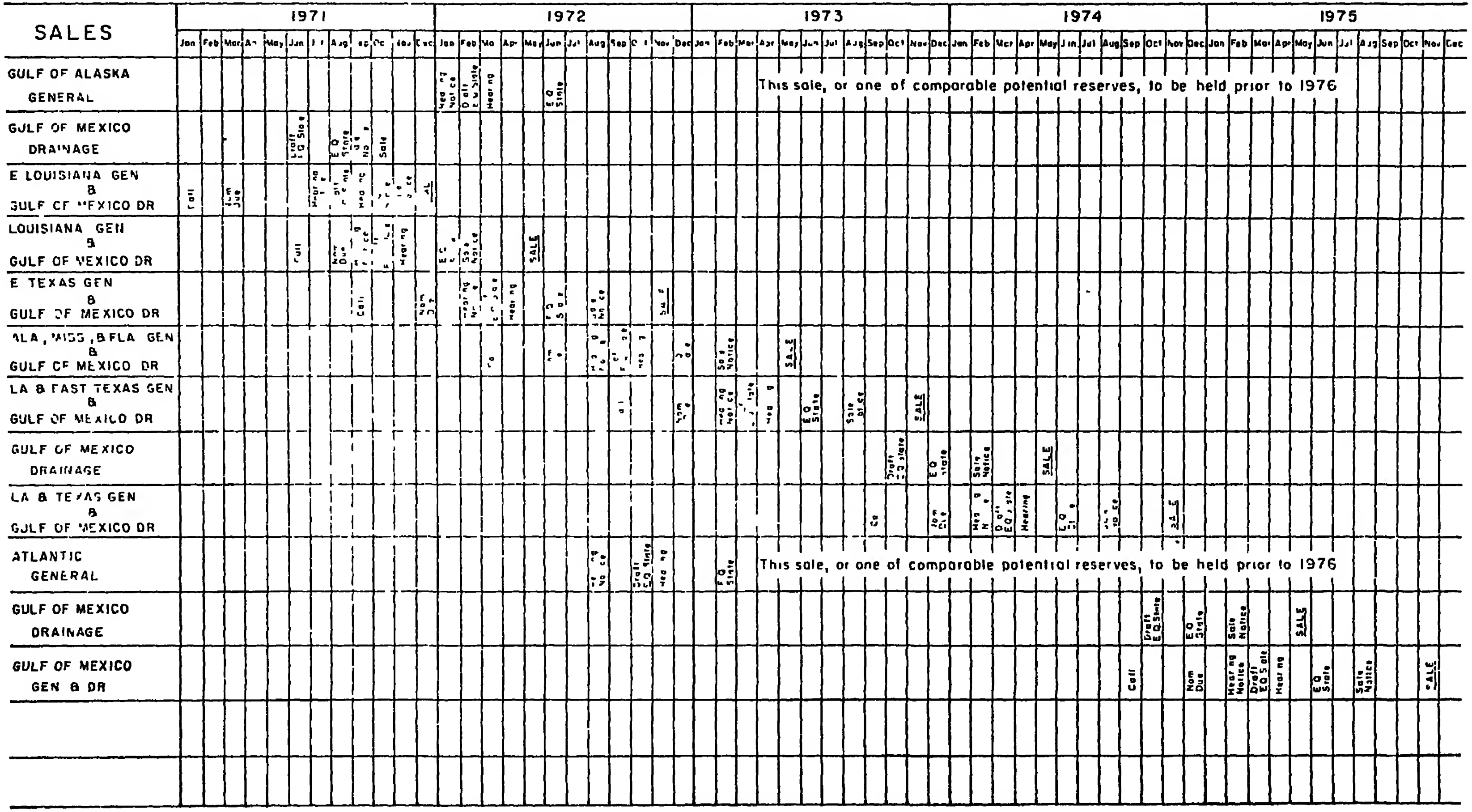
The one-paragraph discussion of the alternative of postponing the sale pending completion of studies which will provide better understanding of its environmental impact is wholly inadequate. At a minimum, the discussio should list all of these studies, their objectives, their completion dates, and the reduction in environmental impact which might result from postponing the sale until they are completed.

ATTACHMENTS

Attachment A*

TENTATIVE SCHEDULE — OCS LEASING

June 1971



*This schedule is subject to annual revision

ATTACHMENT B

PROPOSED GENERAL SALE

Area	Approx. Water Depth (Feet)	Approx. Distance From Shore* (Statute Miles)	Acreage	Primary Production Anticipated
Galveston Area				
Block 190 (E 1/2)	50	13	2880	Oil
211 (N 1/2)	55	14	2880	"
212 (N 1/2)	55	12	2880	"
325	75	28	5760	Oil and Gas
326	75	27	5760	"
381	80	20	5760	"
382	90	23	5760	"
392 (N 1/2)	90	24	2880	"
393 (N 1/2)	90	22	2880	"
Galveston Area - South Addition				
Block A123	155	55	5760	Gas
A124	160	57	5760	"
A130	155	65	5760	"
A131	160	63	5760	"
A133	165	59	5760	"
A134	165	57	5760	"
A135	170	55	5760	"
A152	170	58	5760	"
A153	170	60	5760	"
A154	170	62	5760	"
A156	180	65	5760	"
A157	185	67	5760	"
A163	170	63	5760	"
A164	160	62	5760	"
A165	175	60	5760	"
A166	180	59	5760	"
A181	205	61	5760	"
A182	190	63	5760	"
A183	205	64	5760	"
A184	205	66	5760	"
A198	240	61	5760	"
A199	230	59	5760	"
A208	265	62	5760	"
A209	270	63	5760	"

* Measured to the center of the tract

Area	Approx. Water Depth (Feet)	Approx. Distance From Shore* (Statute Miles)	Acreage	Primary Production Anticipated
High Island Area				
Block 92	45	17	5760	Gas
110	45	18	5760	"
111	45	20	5760	"
141 (W 1/2)	50	17	2880	"
142	50	16	5760	"
154 (N 1/2)	50	18	2880	"
200	30	32	5760	"
High Island Area - South Addition				
Block A442	170	80	5760	"
A446	165	78	5760	"
A447	160	76	5760	"
A448	160	74	5760	"
A457	145	65	5760	"
A463	165	77	5760	"
A464	170	78	5760	"
A465	175	80	5760	"
A474	170	79	5760	"
A475	165	78	5760	"
A480	155	67	5760	"
A481	150	65	5760	"
A482	160	67	5760	"
A483	165	69	5760	"
A488	175	79	5760	"
A489	175	81	5760	"
A495	220	93	5760	"
A496	220	91	5760	"
A502	180	80	5760	"
A513	190	81	5760	"
A518	210	92	5760	"
A519	215	93	5760	"
A520	225	95	5760	"
A521	235	97	5760	"
A532	185	75	5760	"
A533	185	74	5760	"
A534	180	76	5760	"
A535	195	78	5760	"
A555	275	86	5760	"

* Measured to the center of the tract

Area	Approx. Water Depth (Feet)	Approx. Distance From Shore* (Statute Miles)	Acreage	Primary Production Anticipated
High Island Area				
South Addition (cont')				
Block A556	245	84	5760	Gas
A558	210	80	5760	"
A559	210	78	5760	"
A563	315	86	5760	"
A564	305	88	5760	"
A570	280	102	5760	"
A571	280	104	5760	"
A572	295	105	5760	"
A573	330	107	5760	"
High Island Area -				
East Addition				
Block 46	20	17	5760	"
High Island Area				
East Addition - South Extension				
Block A262	150	85	5760	"
A263	150	84	5760	"
A272	160	88	5760	"
A273	160	88	5760	"
A274	160	89	5760	"
A275	165	89	2911	"
A276	180	92	4350	"
A277	175	92	5760	"
A278	180	91	5760	"
A279	175	90	5760	"
A283	170	83	5760	"
A298	195	94	5760	"
A299	195	92	5760	"
A304	210	94	5760	"
A305	205	96	5760	"
A312	210	104	5760	"
A313	210	104	5760	"
A314	210	102	5760	"
A317	215	96	5760	"
A322	235	98	5760	"
A323	225	100	5760	"
A324	220	102	5760	"

* Measured to the center of the tract

Area	Approx. Water Depth (Feet)	Approx. Distance From Shore* (Statute Miles)	Acreage	Primary Production Anticipated
High Island Area - East Addition - South Extension (cont')				
Block A325	215	104	5760	Gas
A326	225	106	5760	"
A327	220	107	5760	"
A328	210	108	2880	"
A329	185	108	2907	"
A330	270	111	4346	"
A331	250	111	2880	"
A332	230	110	5760	"
A333	220	109	5760	"
A334	220	106	5760	"
A336	235	102	5760	"
A337	235	100	5760	"
A340	205	99	5760	"
A341	245	101	5760	"
A350	295	117	4345	"
A351	290	116	5760	"
A358	240	104	5760	"
A359	200	102	5760	"
A360	250	104	5760	"
A361	275	106	5760	"
A368	335	119	5760	"
A369	360	120	2880	"
A370	390	120	2904	"
West Cameron Area - South Addition				
Block 528	175	90	5000	"
586	235	110	5000	"
595	250	113	5000	"
East Cameron Area - South Addition				
Block 269	160	78	5000	"
335	270	104	5000	"

*Measured to the center of the tract

ATTACHMENT C.

GEOLOGIC TIME CHART

AGE DIVISIONS			TIME			
ERA	PERIOD	EPOCH	DURATION IN MILLIONS OF YEARS — ERA	PERIOD	EPOCH	BEGINNING MILLIONS OF YEARS AGO
CENOZOIC	QUATER-NARY	RECENT	63.011	1.011	0.011	0.011
		PLEISTOCENE			2	2
	TERTIARY	PLIOCENE		62	12	13
		MIOCENE			12	25
		OLIGOCENE			11	36
		EOCENE			22	58
		PALEOCENE			5	63
MESOZOIC	CRETACEOUS		167	72		135
	JURASSIC			46		181
	TRIASSIC			49		230
PALEOZOIC	PERMIAN		370	50		280
	PENNSYLVANIAN			40		320
	MISSISSIPPIAN			25		345
	DEVONIAN			60		405
	SILURIAN			20		425
	ORDOVICIAN			75		500
	CAMBRIAN			100		600
PRE-CAMBRIAN	GRENVILLE OROGENY		4000			1000
	OLDEST KNOWN ROCKS IN NORTH AMERICA					3200
	OLDEST KNOWN ROCKS (MURMANSK AREA)					3400
	PROBABLE AGE OF THE EARTH					4600

Attachment D

Summary

Recreation and Fish and Wildlife Areas Along the Gulf of Mexico Coast-Louisiana and Texas

Area	State	Type of Area	Ownership	Acreage
(1) Chandeleur Island	Louisiana	Recreation	State	4,420
(2) Grande Isle	Louisiana	Recreation	State and private	1,000 (126 - State)
(3) Fontembleau State Park	Louisiana	Recreation	State	2,755
(4) Fort Pike State Park	Louisiana	Recreation	State	125
(5) Fort McComb State Park	Louisiana	Recreation	State	20
(6) Sabine	Louisiana	Wildlife Refuge	Federal	142,845
(7) Lacassine	Louisiana	Wildlife Refuge	Federal	31,776
(8) Delta	Louisiana	Wildlife Refuge	Federal	48,799

(ATTACHMENT D, Con't.)

Area	State	Type of Area	Ownership	Acreage
(9) Shell Keys	Louisiana	Wildlife Refuge	Federal	8
(10) Breton Island	Louisiana	Wildlife Refuge	Federal	9,047
(11) Rockefeller	Louisiana	Wildlife Refuge and Game Preserve	State	86,000
(12) Louisiana State	Louisiana	Wildlife Refuge and Game Preserve	State	15,000
(13) Marsh Island	Louisiana	Wildlife Refuge and Game Preserve	State	83,000
(14) St. Tammany	Louisiana	Wildlife Refuge	State	1,310
(15) Paul J. Rainey	Louisiana	Wildlife Refuge and Game Preserve	Private	29,000
(16) Bonne Carre	Louisiana	Game Management Area	State	3,789
(17) Biloxi	Louisiana	Wildlife Management Area	State	39,728
(18) Pass-A-Loutre	Louisiana	Game and Fish Preserve State Hunting Ground	State	66,000

(ATTACHMENT D, Con't.)

Area	State	Type of Area	Ownership	Acreage
(19) Wisner	Louisiana	Wildlife Management Area	State	30,000
(20) Bohemia	Louisiana	Game Management Area	State	30,000
(21) Pointe Au Chien	Louisiana	Wildlife Management Area	State	27,504
(22) Salvador	Louisiana	Wildlife Management Area	State	28,469
(23) Anahuac	Texas	Wildlife Refuge	Federal	9,836
(24) Brazoria	Texas	Wildlife Refuge	Federal	6,604
(25) J. D.Murphree	Texas	Wildlife Management Area	State	8,403
(26) Aransas	Texas	Wildlife Refuge	Federal	54,829
(27) Laguna Atascosa	Texas	Wildlife Refuge	Federal	45,147
(28) San Bernard	Texas	Wildlife Refuge	Federal	14,915
(29) Velasco State Park	Texas	Recreation	State	undetermined
(30) Galveston Island State Park	Texas	Recreation	State	1,922
(31) Brazos Island State Park	Texas	Recreation	State	217
(32) P[illegible] Island			-	[illegible]

(ATTACHMENT D, Con't.)

Area	State	Type of Area	Ownership	Acreage
(32) Texas State Park in Jefferson County (proposed)	Texas	Recreation	State	undetermined

ATTACHMENT E

Inventory of Public Water-Based Recreation Areas: (1)

(Texas and Louisiana Coastal Areas)

Texas

Code Number	Name of Area	Annual Visitation	County
132	Port Neches Municipal Park	4,000	Jefferson
133	Anahuac National Wildlife Refuge	18,250	Chambers
134	San Jacinto Battlegrounds	60,000	Harris
135	Stewart Beach Park		Galveston
136	Sheldon Fish Hatchery		Harris
137	Indianola State Historic Park		Calhoun
138	Velasco State Scenic Park		Brazoria
139	City of Port Lavaca	25,000	Calhoun
140	Port Lavaca Causeway State Recreation Park		Calhoun
141	Second Chain of Island Wildlife Refuge		Calhoun
142	Arkansas National Wildlife Refuge	25,000	Aransas
143	Goose Island State Recreation Park	112,476	Aransas
144	Lydia Ann Island Wildlife Refuge		Nueces
145	Port Aransas-Corpus Christi Waterway Recreation Area	12,000	Nueces
146	Holiday Beach Park		Nueces
147	South Guth Park	10,000	Nueces
148	Bay Front		Nueces
149	Cole Park		Nueces

(ATTACHMENT E, Con't.)

Texas (Continued)

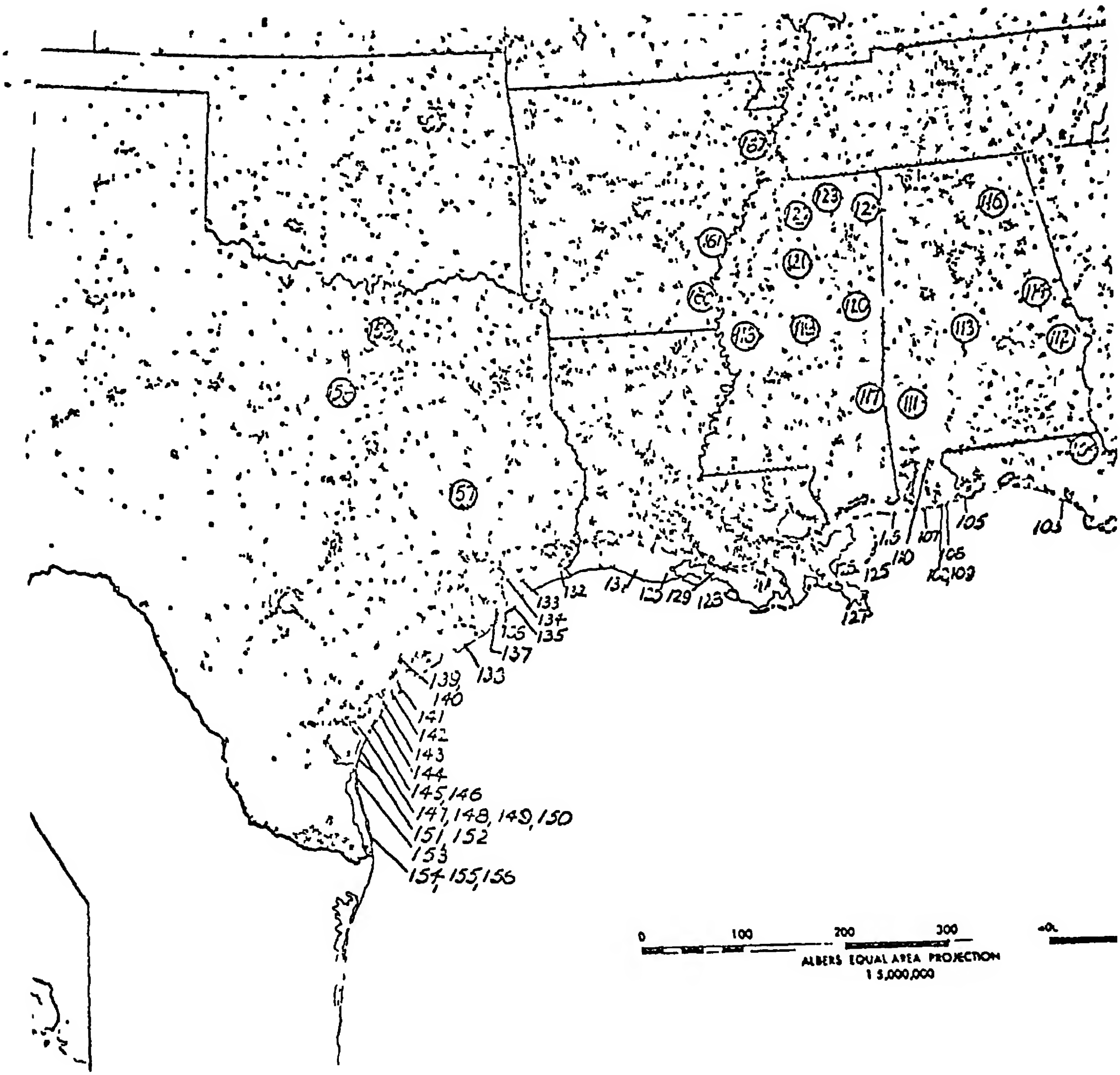
Code Number	Name of Area	Annual Visitation	County
150	U.S.N.A.S., Corpus Christi	91,250	Nueces
151	Gulf Park Number 1.	10,000	Nueces
152	Gulf Park Number 2.		Nueces
153	Padre Island National Seashore	2,203,000	Kenedy
154	Green Island in Laguna Madre Refuge		Cameron
155	Laguna Atascosa National Wildlife Refuge	8,700	Cameron
156	Brazos Island State Scenic Park		Cameron
157	Trinity River Park	14,000	Madison
158	Trinity Park	850,000	Tarrant
159	Lewisville Fish Hatchery		Denton

Louisiana

Code Number	Name of Area	Annual Visitation	County
125	Breton National Wildlife Refuge		St. Bernard
126	Pass-A-Loutre Waterfowl Management Area	7,300	Plaquemines
127	Delta National Wildlife Refuge		Plaquemines
128	Marsh Island Refuge	3,150	St. Mary
129	Cypremont Point Beach Number 1 Cypremont Point Beac. Number 2		St. Mary St. Mary
130	State Wildlife Refuge (Vermillion)	1,500	Vermillion
131	Rutherford Beach	36,000	Cameron

(1) 1965 Bureau of Outdoor Recreation Survey - being revised 1972.

(ATTACHMENT E, Con't.)



SUMMARY OF PUBLIC PARKS AND RECREATION AREAS CONTIGUOUS TO TEXAS BAYS AND
(ATTACH. E, GULF COAST FROM FREEPORT (BRAZORIA COUNTY) TO ORANGE COUNTY (1)
Con't.)

County	Park Name	Administration		Acres
Brazoria	Boat Ramp	County		2.
	Boat Ramp	County		10.
	Quintana Bryan County Beach	County		157.
	Surfside County Beach	County		304.
	Bryan Beach State Park	State		554.
			Total	1,027
Galveston	Galveston Island State Park	State		1,421.
	West Galveston County Beach	County		1,660.
	Washington City Park	Municipal		3.
	Municipal Golf Course	Municipal		140.
	37th Street Groin County Park	County		3.
	29th Street Groin County Park	County		3.
	Menard City Park	Municipal		6.
	10th Street Groin County Park	County		2.
	Stewart Beach City Park	Municipal		49.
	South Jetty COE Park	COE		59.
	North Jetty COE Park	COE		113.
	Fort Travis County Park	County		10.
	Tarpey City Park	Municipal		18.
	Houston Power & Lighting Public Recreation Area	Utility		16.
	Galveston County Fish Pier	County		2.
	Keman County Park	County		2.
	Baycliff County Park	County		14.
	Deer Hole City Park	Municipal		.5
	Shell Bottom City Park	Municipal		.4
	Memorial City Park	Municipal		.3
	Texas City County Dike	County		75.
			Total	3,597.2
Harris	San Jacinto State Park	State		100.
	Britton I City Park	Municipal		12.
	Britton II City Park	Municipal		30.
	City of Seabrook Municipal Park	Municipal		24.
	Clear Creek County Park	County		110.
			Total	276.
Chambers	McCullem County Park	County		10.
	Bun's Beach County Park	County		42.
	County Land Park	County		50.
	Fort Anahuac City Park	Municipal		40.
	Double Bayou County Park	County		30.
	Job Beason County Park	County		12.
	James H. Robbins County Park	County		10.
	Anahuac National Wildlife Refuge	Federal		9,837.
			Total	10,031.
Jefferson	Jefferson County State Park	State		14,360.
	Logan City Park	City		700.
	Pleasure Island	City		2,560.
			Total	17,620
			Grand Total	32,551.2

(1) Source: [illegible]

(ATTACHMENT E, Con't.)

Estimates of Outdoor Recreation Participation for Selected Activities on the Upper Texas Gulf Coast: 1968

Counties Included: Brazoria, Chambers, Harris, Galveston, Jefferson (See Map 1)

Aggregate Estimates by Activity:

Activity	Participation (days)
Boating	1,976,743
Camping	1,765,456
Fishing	5,998,096
Hunting	153,704
Sightseeing	3,121,863
Picnicking	5,224,146
Surfing	875,202
Swimming	15,785,679
TOTAL	34,900,889

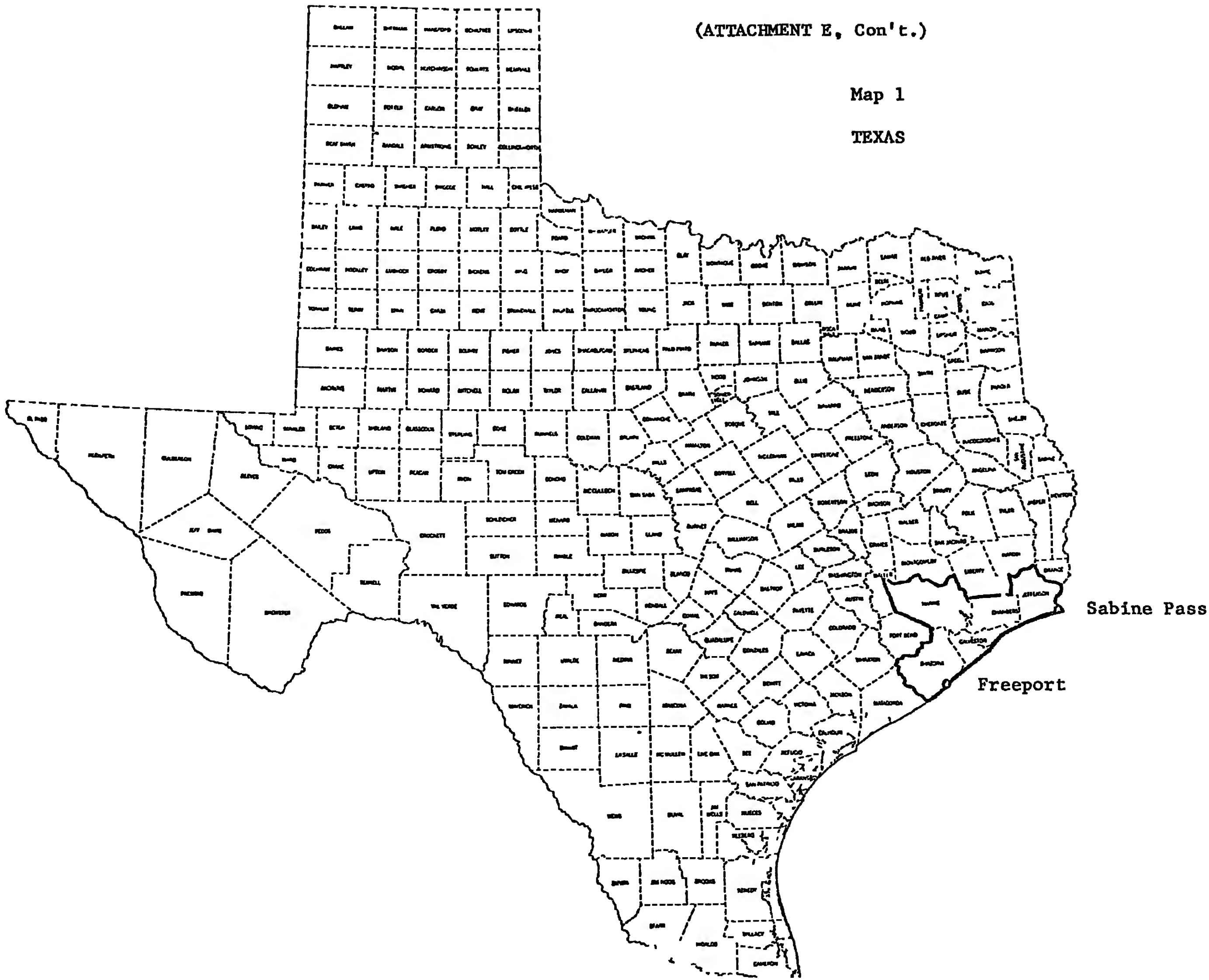
Source: Texas Outdoor Recreation Household Demand Survey, Texas Parks and Wildlife Department.

Note. These figures represent participation for the entire activity and not just saltwater.

(ATTACHMENT E, Con't.)

Map 1

TEXAS



ATTACHMENT F

MATRIX APPENDIX

The following contains a presentation of a matrix table for each individual tract proposed for offering in this sale. The following code will appear at the top of each matrix table and should be translated in accordance with the following.

1	2	3	4	5

1. Leasing Area

   G = Galveston

   G-S = Galveston - South Addition

   HI = High Island

   HI-S = High Island - South Addition

   HI-E = High Island - East Addition

   HI-ES = High Island - East Addition, South Extension

   WC-S = West Cameron - South Addition

   EC-S = East Cameron - South Addition

2. Block Number
3. Statute miles from block to shore
4. Water depth of block
5. Estimated type of production

   O = Oil G = Gas O & G = Oil and Gas

ATTACHMENT F, Con't.

In addition the following legend will explain the letter headings for columns within each matrix table:

IM = Importance

PR = Proximity

F(ST) = Impact Factor - Strutures

F(OS) = Impact Factor - Oil Spills

NCG = Not Computed for Gas only Blocks

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G | 190 | 13 | 50 | 0

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.0	0
Unique & Highly Productive Areas	20	0.0	0	100	0.5	50
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.5	40
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.5	40
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G | 212 | 12 | 55 | 0

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.5	50
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.5	40
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	0.9	18
Outdoor Recreation	40	0.0	0	80	0.5	40
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G | 211 | 14 | 55 | 0

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.5	50
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.5	40
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.5	40
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G | 325 | 28 | 75 | [illegible]

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.1	10
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.1	0	40	0.1	40
Beaches	40	0.0	0	80	0.1	8
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	0.9	18
Outdoor Recreation	40	0.0	0	80	0.1	8
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G	326	27	75	O&G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.1	10
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.1	8
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.1	8
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G	381	20	80	O&G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.2	20
Unique & Highly Productive Areas	20	0.0	0	100	0.3	30
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.3	24
Coastal Activities/Multiple Uses:						
Shipping	80	0.8	64	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.3	24
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G	382	23	90	O&G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.2	20
Unique & Highly Productive Areas	20	0.0	0	100	0.2	20
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.2	16
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.2	16
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G	392	24	90	O&G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.2	20
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.1	0	40	1.0	40
Beaches	40	0.0	0	80	0.2	16
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.2	16
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G	393	22	90	O&G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100	0.1	10
Unique & Highly Productive Areas	20	0.0	0	100	0.2	20
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	1.0	40
Beaches	40	0.0	0	80	0.2	16
Coastal Activities/Multiple Uses.						
Shipping	80	0.4	32	20	1.0	20
Outdoor Recreation	40	0.0	0	80	0.2	16
Commercial Fishing	80	1.0	80	80	1.0	80
Sport Fishing	0	1.0	0	80	1.0	80

G-S	123	55	155	G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	124	57	160	G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		

G-S	130	65	155	G

SIGNIFICANT RESOURCE FACTORS	Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills (1000 bbl+) PR	Oil Spills (1000 bbl+) F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	131	63	160	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1 0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0 4	32	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	133	59	165	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	134	57	165	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems·						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.1	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses·						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	135	55	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	152	58	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	153	60	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0 6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	154	62	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses·						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.6	48	80		

G-S	156	65	180	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nuisery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	157	67	185	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	163	63	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	164	62	160	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	165	60	175	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	166	59	180	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	181	61	205	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	182	63	190	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses·						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	183	64	205	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	184	66	205	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

G-S	198	61	240	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

G-S	199	59	230	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0 0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

G-S	208	62	265	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

G-S	209	63	270	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0 0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0 4	32	80		
Sport Fishing	0	0.0	0	80		

HI	92	17	45	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.3	6	100		NCG
Unique & Highly Productive Areas	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.4	8	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.4	16	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

HI	110	18	45	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1 0	80	80		

HI	111	20	45	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1 0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI	141	17	50	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

HI	142	16	50	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	0.0	0	80		

HI	154	18	50	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

HI	200	32	30	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40	-	
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S	442	86	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	00	0	80		

HI-S	446	78	165	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S	447	76	160	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	00	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0 0	0	20		
Outdoor Recreation	40	00	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S	448	74	160	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F.

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S | 457 | 65 | 145 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 463 | 77 | 165 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 464 | 78 | 170 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 465 | 80 | 175 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S | 474 | 79 | 170 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk.	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 475 | 78 | 165 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk.	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 480 | 67 | 155 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 481 | 65 | 150 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.8	64	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S | 482 | 67 | 160 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 483 | 69 | 165 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.8	64	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 488 | 79 | 175 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk.	20	0.6	12	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S | 489 | 81 | 175 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S | 495 | 93 | 220 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S | 496 | 91 | 220 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S | 502 | 80 | 180 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk.	20	1.0	20	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
[illegible]	0	0.0	0	80		

HI-S | 513 | 81 | 190 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas Stetson Bk.	20	1.0	20	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S	518	92	210	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0 6	48	80		
Sport Fishing	0	0 0	0	80		

HI-S	519	93	215	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S	520	95	225	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses·						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0 0	0	80		

HI-S	521	97	235	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S	532	75	185	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1 0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	1 0	80	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S	533	74	185	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1 0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S	534	76	180	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses·						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.6	48	80		
[illegible]	0	0 0	0	80		

HI-S	535	78	195	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S 555 86 234 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas Stetson Bk.	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S 556 84 245 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas Stetson Bk.	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S 558 80 210 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-S 559 78 210 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S 563 86 295 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S 564 88 305 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S 570 102 280 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S 571 104 280 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-S | 572 | 105 | 295 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	6	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-S | 573 | 107 | 330 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-E | 46 | 17 | 20 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0 0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.6	48	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	1.0	80	80		
Sport Fishing	0	1.0	0	80		

HI-ES | 262 | 85 | 150 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES | 263 | 84 | 150 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0 0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0 0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0 6	48	80		
Sport Fishing	0	0 0	0	80		

HI-ES | 272 | 88 | 160 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 273 | 88 | 160 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems.						
Refuges/Management Areas	20	0 0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0 0	0	80		
Commercial Fishing	80	0 6	48	80		

HI-ES | 274 | 89 | 160 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	275	89	165	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.2	16	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	276	92	180	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	277	92	175	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	278	91	180	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	279	90	175	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	283	83	170	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	298	94	195	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	299	92	195	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	304	94	210	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	305	96	205	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	312	104	210	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	313	104	210	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	314	102	210	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	317	96	215	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES	322	98	235	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
[illegible]	0	0.0	0	80		

HI-ES	323	100	225	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES | 324 | 102 | 220 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 325 | 104 | 215 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 326 | 106 | 225 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 327 | 107 | 220 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES | 328 | 108 | 210 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses.						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 329 | 108 | 185 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES | 330 | 111 | 264 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses'						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
	0	0.0	0	80		

HI-ES | 331 | 111 | 264 | G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS					
	Structures			Oil Spills (1000 bbl+)		
	IM	PR	F(ST)	IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses'						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES 324 102 220 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 325 104 215 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 326 106 225 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 327 107 220 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES 328 108 210 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES 329 108 185 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES 330 111 264 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems						
Refuges/Management Areas	20	0.0	0	100		NCG
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses						
Shipping	80	0.0	0	20		

HI-ES 331 111 264 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES 332 110 230 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 333 109 220 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 334 106 220 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 336 102 235 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES 337 100 235 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES 340 99 205 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES 341 101 245 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
	40	0.0	0	80		

HI-ES 350 117 295 G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						NCG
Refuges/Management Areas	20	0.0	0	100		
E. Flower Garden Unique & Highly Productive Areas	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
	80	0.4	32	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	351	116	290	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas E. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES	358	104	240	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES	359	102	200	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	0.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

HI-ES	360	104	250	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

HI-ES	361	106	275	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas W. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES	368	119	335	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas E. Flower Garden	20	0.6	12	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

HI-ES	369	120	360	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas E. Flower Garden	20	0.4	8	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		

HI-ES	370	120	390	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	Structures PR	Structures F(ST)	Oil Spills (1000 bbl+) IM	Oil Spills PR	Oil Spills F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas E. Flower Garden	20	0.2	4	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

WC-S	528	90	175	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	1.0	80	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

WC-S	586	110	235	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

WC-S	595	113	250	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

EC-S	269	78	160	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.0	0	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.6	48	80		
Sport Fishing	0	0.0	0	80		

ATTACH. F

ANALYSIS OF POSSIBLE ADVERSE ENVIRONMENTAL IMPACT

EC-S	335	104	270	G

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20	0.0	0	100		NCG
Unique & Highly Productive Areas	20	0.0	0	100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0	1.0	0	40		
Beaches	40	0.0	0	80		
Coastal Activities/Multiple Uses:						
Shipping	80	0.4	32	20		
Outdoor Recreation	40	0.0	0	80		
Commercial Fishing	80	0.4	32	80		
Sport Fishing	0	0.0	0	80		

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20			100		
Unique & Highly Productive Areas	20			100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0			40		
Beaches	40			80		
Coastal Activities/Multiple Uses:						
Shipping	80			20		
Outdoor Recreation	40			80		
Commercial Fishing	80			80		
Sport Fishing	0			80		

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20			100		
Unique & Highly Productive Areas	20			100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0			40		
Beaches	40			80		
Coastal Activities/Multiple Uses:						
Shipping	80			20		
Outdoor Recreation	40			80		

SIGNIFICANT RESOURCE FACTORS	IMPACT FACTORS: Structures IM	PR	F(ST)	Oil Spills (1000 bbl+) IM	PR	F(OS)
Natural Resource Systems:						
Refuges/Management Areas	20			100		
Unique & Highly Productive Areas	20			100		
Biota Seaward of Estuary/Marsh/Nursery Areas	0			40		
Beaches	40			80		
Coastal Activities/Multiple Uses:						
Shipping	80			20		
Outdoor Recreation	40			80		
[illegible]	80					

ATTACHMENT G

Notice to Lessees and Operators Of Fede

Oil, Gas, And Sulphur Leases

In The Outer Continental Shelf

Gulf Of Mexico Area

OCS Order Nos. 1 through 12—Gulf of Mexico

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
CONSERVATION DIVISION

Branch Of Oil and Gas Operations
Gulf Of Mexico Area

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

MARKING OF WELLS, PLATFORMS, AND FIXED STRUCTURES

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.37. Section 250.37 provides as follows:

> Well designations. The lessee shall mark promptly each drilling platform or structure in a conspicuous place, showing his name or the name of the operator, the serial number of the lease, the identification of the wells, and shall take all necessary means and precautions to preserve these markings.

The operator shall comply with the following requirements. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Identification of Platforms, Fixed Structures. Platforms and structures, other than individual wellhead structures and small structures, shall be identified at two diagonal corners of the platform or structure by a sign with letters and figures not less than 12 inches in height with the following information: The name of lease operator, the name of the area, the block number of the area in which the platform or structure is located, and the platform or structure designation. The information shall be abbreviated as in the following example:

   "The Blank Oil Company operates 'C' platform in Block 37 of South Timbalier Area."

   The identifying sign on the platform would show:

   "BOC - S.T. - 37 - C."

2. Identification of Single Well Structures and Small Structures. Single well and small structures may be identified with one sign only, with letters and figures not less than 3 inches in

height. The information shall be abbreviated as in the following example:

> *"The Blank Oil Company operates well No. 1 which is equipped with a protective structure, in Block 68 in the East Cameron Area."*

The identifying sign on the protective structure would show:

> *"BOC - E.C. - 68 - No. 1"*

3. *Identification of Wells. The OCS lease and well number shall be painted on, or a sign affixed to, each singly completed well. In multiple completed wells each completion shall be individually identified at the well head. All identifying signs shall be maintained in a legible condition.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

DRILLING PROCEDURES OFF LOUISIANA AND TEXAS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.34, 250.41 and 250.91. All exploratory wells drilled for oil and gas shall be drilled in accordance with the provisions of this Order. Initial development wells drilled for oil and gas shall be drilled in accordance with the provisions of this Order which shall continue in effect until field rules are issued. After field rules have been established by the supervisor, development wells shall be drilled in accordance with such rules; except that in fields containing more than five development wells, additional development wells commenced prior to October 1, 1969, may be excluded from provisions of this Order, as approved by the supervisor, to permit time for the establishment of field rules.

Where sufficient geologic and engineering information is obtained through exploratory drilling, operators may make application to the supervisor for the establishment of field rules, but the operator(s) shall make such application before more than five development wells have been drilled in the field. Operators may also make application for the establishment of field rules for existing fields containing more than five development wells on the date of this Order. Each Application to Drill (Form 9-331C) *for exploratory wells and development wells not covered by field rules shall include all information required under 30 CFR 250.91 and the integrated casing, cementing, mud, and blowout prevention program for the well, and shall comply with the following requirements. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).*

1. Well Casing and Cementing. *All wells shall be cased and cemented in accordance with the requirements of 30 CFR 250.41(a)(1). The* Application to Drill (Form 9-331C) shall contain a statement that *all zones which contain* oil, gas, *or fresh water shall be fully* protected by casing and cement. *For the purpose of this Order, the several casing strings in order of normal installation are drive or structural casing, conductor casing, surface casing, intermediate casing, and* production casing. All depths refer *to true vertical depth (TVD).*

A. Drive or Structural Casing. *This casing shall be set by drilling, driving, or jetting to a minimum depth of 100 feet below the Gulf floor or to such greater depth required to support unconsolidated deposits and to provide hole stability for initial drilling operations. If drilled in, the drilling fluid shall be a type that will not pollute the Gulf, and a quantity of cement sufficient to fill the annular space back to the Gulf floor must be used.*

B. Conductor and Surface Casing - General Principles. *Determinatio of proper casing setting depths shall be based upon all geologic factors including the presence or absence of hydrocarbons and water depths on a well-for-well basis. The setting depths of al casing strings shall be determined by taking into account formation fracture gradients and hydrostatic pressure to be contained within the well bore. The conductor and surface casing shall be new pipe or reconditioned pipe that has been tested and inspected to verify a new condition.*

(1) Conductor Casing. *This casing shall be set in accordance with the table below. A quantity of cement sufficient to fill the annular space back to the Gulf floor must be used. The cement may be washed out or displaced to a depth of 40 feet below the Gulf floor to facilitate casing removal upon well abandonment.*

(2) Surface Casing. *This casing shall be set at a depth in accordance with the table below and cemented in a manner necessary to protect all fresh water sands and provide well control until the next string of casing is set. This casing shall be cemented with a quantity sufficient to fill the calculated annular space to (a) at least 1,500 feet above the casing shoe, or (b) within 200 feet below the conductor casing. Whenever there are any indications of improper cementing, such as lost returns, cement channeling, or mechanical failure of equipment, a temperature or cement bond survey shall be run, either before or after remedial cementing, to aid in determining whether the casing is properly cemented. If the annular space is not adequately cemented by the primary operation, the operator shall either recement or squeeze cement the shoe after drilling out.*

(3) Conductor and Surface Casing Setting Depths. *These string of casing shall be set at the depths specified in the following table subject to minor variation to permit the*

casing to be set in a competent bed; provided, however, that the conductor casing shall be set before drilling into shallow formations known to contain oil or gas or, if unknown, upon encountering such formations. These casing strings shall be run and cemented prior to drilling below the specified setting depths. For those wells which may encounter abnormal pressure conditions, the district engineer may prescribe the exact setting depth within the ranges specified below.

Required Setting Depth Below Gulf Floor (TVD in feet)

Proposed Total Depth of Well or Depth of First Full String of Intermediate Casing (TVD in feet from Rorary Table)	Surface Casing Minimum	Surface Casing Maximum	Conductor Casing Minimum	Conductor Casing Maximum
0 - 7,000	1,500	2,500	300	800
7,000 - 9,000	1,750	3,000	400	800
9,000 -11,000	2,250	3,500	500	900
11,000 -13,000	3,000	4,000	600	900
13,000 -Below	3,500	4,500	700	1,000

C. *Intermediate Casing. This string of casing shall be set when required by anticipated abnormal pressure, mud weights, sediment and other well conditions. The intermediate casing shall be new pipe or reconditioned pipe that has been tested and inspected to verify a new condition. A quantity of cement sufficient to cover and isolate all hydrocarbon zones and to isolate abnormal pressure intervals from normal pressure intervals shall be used. If a liner is used as an intermediate string, the cement shall be tested by a fluid entry or pressure test to determine whether a seal between the liner top and next larger string has been achieved. The test shall be recorded on the driller's log. When such liner is used as production casing, it shall be extended to the surface and cemented to avoid surface casing being used as production casing.*

D. *Production Casing. This string of casing shall be set before completing the well for production. The production casing shall be new pipe or reconditioned pipe that has been tested and inspected to verify a new condition. It shall be cemented in a manner necessary to cover or isolate all zones which contain hydrocarbons, but in any case, a calculated volume sufficient to fill the annular space at least 500 feet above the uppermost producible hydrocarbon zone must be used. When a liner is used as production casing, the testing of the seal between the liner top and next larger string shall be conducted as in the case of intermediate liners.*

E. Pressure Testing. Prior to drilling the plug after cementing, all casing strings, except the drive or structural casing, shall be pressure tested as shown in the table below. This test shall not exceed the working pressure of the casing. The surface casing shall be tested with water in the top 100 feet of the casing. If the pressure declines more than 10% in 30 minutes, or if there is other indication of a leak, the casing shall be recemented, repaired, or an additional casing string run, and the casing shall be tested again in the same manner.

Casing String	*Minimum Pressure Test (psi)*
Conductor	*200*
Surface	*1,000*
Intermediate	*1,500 or 0.2 psi/ft., whichever is greater*
Liner	*1,500 or 0.2 psi/ft., whichever is greater*
Production	*1,500 or 0.2 psi/ft., whichever is greater*

After cementing any of the above strings, drilling shall not be commenced until a time lapse of:

(1) 24 hours, or

(2) 8 hours under pressure for conductor casing string. 12 hours under pressure for all other strings. (Cement is considered under pressure if one or more float valves are employed and are shown to be holding the cement in place or when other means of holding pressure is used.)

All casing pressure tests shall be recorded on the driller's log.

2. Blowout Prevention Equipment. Blowout preventers and related well control equipment shall be installed, used, and tested in a manner necessary to prevent blowouts. Prior to drilling below the conductor casing, blowout prevention equipment shall be installed and maintained ready for use until drilling operations are completed, as follows:

A. Conductor Casing. Before drilling below this string, at least one remotely controlled bag-type blowout preventer and equipment for circulating the drilling fluid to the drilling structure or vessel shall be installed. To avoid formation fracturing from complete shut-in of the well, a large diameter pipe with control valves shall be installed on the conductor casing below the blowout preventer so as to permit the diversion of hydrocarbons and

other fluids; except that when the blowout preventer assembly is on the Gulf floor, the choke and kill lines shall be equipped to permit the diversion of hydrocarbons and other fluids.

B. <u>Surface Casing</u>. Before drilling below this string the blowout prevention equipment shall include a minimum of: (1) three remotely controlled, hydraulically operated, blowout preventers with a working pressure which exceeds the maximum anticipated surface pressure, including one equipped with pipe rams, one with blind rams, and one bag-type; (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke manifold; (4) a kill line; and (5) a fill-up line.

C. <u>Intermediate Casing</u>. Before drilling below this string the blowout prevention equipment shall include a minimum of: (1) four remotely controlled, hydraulically operated, blowout preventers with a working pressure which exceeds the maximum anticipated surface pressure, including at least one equipped with pipe rams, one with blind rams, and one bag-type; (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke manifold; (4) a kill line; and (5) a fill-up line.

D. <u>Testing</u>. Ram-type blowout preventers and related control equipment shall be tested with water to the rated working pressure of the stack assembly or to the working pressure of the casing, whichever is the lesser, (1) when installed; (2) before drilling out after each string of casing is set; (3) not less than once each week while drilling; and (4) following repairs that require disconnecting a pressure seal in the assembly. The bag-type blowout preventer shall be tested to 70 percent of the above pressure requirements.

While drill pipe is in use ram-type blowout preventers shall be actuated to test proper functioning once each trip, but in no event less than once each day. The bag-type blowout preventer shall be actuated on the drill pipe once each week. Accumulators or accumulators and pumps shall maintain a pressure capacity reserve at all times to provide for repeated operation of hydraulic preventers. A blowout prevention drill shall be conducted weekly for each drilling crew to insure that all

equipment is operational and that crews are properly trained to carry out emergency duties. All blowout preventer tests and crew drills shall be recorded on the driller's log.

E. Other Equipment. An inside blowout preventer assembly (back pressure valve) and drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. Separate valves shall be maintained on the rig floor to fit all pipe in the drill string. A Kelly cock shall be installed below the swivel, and an essentially full opening Kelly cock shall be installed at the bottom of the Kelly of such design that it can be run through the blowout preventers.

3. Mud Program - General. The characteristics, use, and testing of drilling mud and the conduct of related drilling procedures shall be such as are necessary to prevent the blowout of any well. Quantities of mud materials sufficient to insure well control shall be maintained readily accessible for use at all times.

A. Mud Control. Before starting out of hole with drill pipe, the mud shall be circulated with the drill pipe just off bottom until the mud is properly conditioned. When coming out of the hole with drill pipe, the annulus shall be filled with mud before the mud level drops below 100 feet, and a mechanical device for measuring the amount of mud required to fill the hole shall be utilized. The volume of mud required to fill the hole shall be watched, and any time there is an indication of swabbing, or influx of formation fluids, the necessary safety device(s) required in subparagraph 2(E) above shall be installed on the drill pipe, the drill pipe shall be run to bottom, and the mud properly conditioned. The mud shall not be circulated and conditioned except on or near bottom, unless well conditions prevent running the pipe to bottom. The mud in the hole shall be circulated or reverse circulated prior to pulling drill stem test tools from the hole.

B. Mud Testing Equipment. Mud testing equipment shall be maintained on the drilling platform at all times, and mud tests shall be performed daily, or more frequently as conditions warrant.

The following mud system monitoring equipment must be installed (with derrick floor indicators) and used throughout the period of drilling after setting and cementing the conductor casing:

(1) Recording mud pit level indicator to determine mud pit volume gains and losses. This indicator shall include a visual or audio warning device.

(2) Mud volume measuring device for accurately determining mud volumes required to fill the hole on trips.

(3) Mud return indicator to determine that returns essentially equal the pump discharge rate.

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

PLUGGING AND ABANDONMENT OF WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.15. The operator shall comply with the following minimum plugging and abandonment procedures which have general application to all wells drilled for oil and gas. Plugging and abandonment operations must not be commenced prior to obtaining approval from an authorized representative of the Geological Survey. Oral approvals shall be in accordance with 30 CFR 250.13. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Permanent Abandonment.

A. Isolation in Uncased Hole. In uncased portions of wells, cement plugs shall be spaced to extend 100 feet below the bottom to 100 feet above the top of any oil, gas, and fresh water zones so as to isolate them in the strata in which they are found and to prevent them from escaping into other strata.

B. Isolation of Open Hole. Where there is open hole (uncased and open into the casing string above) below the casing, a cement plug shall be placed in the deepest casing string by (1) or (2) below, or in the event lost circulation conditions exist or are anticipated, the plug may be placed in accordance with (3) below:

(1) A cement plug placed by displacement method so as to extend a minimum of 100 feet above and 100 feet below the casing shoe.

(2) A cement retainer with effective back pressure control set not less than 50 feet, nor more than 100 feet, above the casing shoe with a cement plug calculated to extend at least 100 feet below the casing shoe and 50 feet above the retainer.

(3) A permanent type bridge plug set within 150 feet above the casing shoe with 50 feet of cement on top of the bridge plug. This plug shall be tested prior to placing subsequent plugs.

C. *Plugging or Isolating Perforated Intervals.* A cement plug shall be placed opposite all open perforations (perforations not squeezed with cement) extending a minimum of 100 feet above and 100 feet below the perforated interval or down to a casing plug whichever is less. In lieu of the cement plug, a bridge plug set at a maximum of 150 feet above the open perforations with 50 feet of cement on top may be used provided the perforations are isolated from the hole below.

D. *Plugging of Casing Stubs.* If casing is cut and recovered, a cement plug 200 feet in length shall be placed to extend 100 feet above and 100 feet below the stub. A retainer may be used in setting the required plug.

E. *Plugging of Annular Space.* No annular space that extends to the Gulf floor shall be left open to drilled hole below. If this condition exists, the annulus shall be plugged with cement.

F. *Surface Plug Requirement.* A cement plug of a least 150 feet, with the top of the plug 150 feet or less below the Gulf floor, shall be placed in the smallest string of casing which extends to the surface.

G. *Testing of Plugs.* The setting and location of the first plug below the top 150-foot plug, will be verified by either (1) placing a minimum pipe weight of 15,000 pounds on the plug, or (2) testing with a minimum pump pressure of 1,000 psig with no more than a 10 percent pressure drop during a 15-minute period.

H. *Mud.* Each of the respective intervals of the hole between the various plugs shall be filled with mud fluid of sufficient density to exert hydrostatic pressure exceeding the greatest formation pressure encountered while drilling such interval.

I. *Clearance of Location.* All casing and piling shall be severed and removed to at least 15 feet below the Gulf floor and the location shall be dragged to clear the well site of any obstructions.

2. *<u>Temporary Abandonment</u>. Any drilling well which is to be temporarily abandoned shall be mudded and cemented as required for permanent abandonment except for requirements F and I of paragraph 1 above. When casing extends above the Gulf floor, a mechanical bridge plug (retrievable or permanent) shall be set in the casing between 15 and 200 feet below the Gulf floor.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

SUSPENSIONS AND DETERMINATION OF WELL PRODUCIBILITY

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.12(d)(1). An OCS lease provides for extension beyond its primary term for as long as oil or gas may be produced from the lease in paying quantities. An OCS lease may be maintained beyond the primary term, in the absence of actual production, when a suspension of operations or production, or both, has been approved. An application for suspension of production for an initial period should be submitted prior to the expiration of the term of a lease. The supervisor may approve a suspension of production provided at least one well has been drilled on the lease and determined to be capable of being produced in paying quantities. The temporary or permanent abandonment of a well will not preclude approval of a suspension of production as provided in 30 CFR 250.12(d)(1). Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

A well may be determined to be capable of producing in paying quantities when the requirements of either 1 or 2 below have been met.

1. Production Tests.

   A. Oil Wells. A production test of at least two hours duration, following stabilization, is required.

   B. Gas Wells. A deliverability test of at least two hours duration, following stabilization, or a four-point back-pressure test, is required.

   C. Witnessing and Results. All tests must be witnessed by an authorized representative of the Geological Survey. Test data accompanied by operator's affidavit, or third-party test data, may be accepted in lieu of a witnessed test provided prior approval is obtained from the appropriate district office. The results of the witnessed or accepted test must justify a determination that the well is capable of producing in paying quantities.

2. *<u>Production Capability</u>. Information for determining producibility should be submitted in time to permit one week for evaluation and determination. In cases of urgency, determinations may be conveyed orally. The following may be considered as acceptable evidence that a well is capable of producing in paying quantities:*

   A. *An induction-electric log of the well, clearly showing a minimum of 15 feet of producible sand in one section which does not include any interval which appears to be water saturated. All of the section counted as producible must exhibit the following properties:*

      (1) *Electrical spontaneous potential exceeding 20 negative millivolts beyond the shale base line. If mud conditions prevent a 20 negative millivolt reading beyond the shale base line, a gamma ray log deflection of at least 70 percent of the maximum gamma ray deflection in the nearest clean water bearing sand may be substituted.*

      (2) *A minimum true resistivity ratio of the producible section to the nearest clean water sand of at least 5:1, provided the producible section exhibits a minimum resistivity of 2.0 ohm-meters.*

      (3) *A porosity log indicating porosity in the producible section.*

   B. *Sidewall cores and core analysis which indicates that the section is producible.*

   C. *A wire line formation test or evidence that an attempt was made to obtain such test. The test results must indicate that the section is producible.*

   D. *All logs run must support other evidence that the section is producible.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

INSTALLATION OF SUBSURFACE SAFETY DEVICE

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.41(b). Section 250.41(b) provides as follows:

> *(b) Completed Wells. In the conduct of all its operations, the lessee shall take all steps necessary to prevent blowouts, and the lessee shall immediately take whatever action is required to bring under control any well over which control has been lost. The lessee shall: (1) in wells capable of flowing oil or gas, when required by the supervisor, install and maintain in operating condition storm chokes or similar subsurface safety devices; (2) for producing wells not capable of flowing oil or gas, install and maintain surface safety valves with automatic shutdown controls; and (3) periodically test or inspect such devices or equipment as prescribed by the supervisor.*

The operator shall comply with the following requirements. All departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b). All applications for approval under the provisions of this Order shall be submitted to the appropriate District office. References in this Order to approvals, determinations, or requirements are to those given or made by the Supervisor or his delegated representative.

1. *Installation. All new and existing tubing installations open to hydrocarbon-bearing zones shall be equipped with a subsurface-controlled or a surface- or other remotely controlled subsurface safety device, to be installed at a depth of 100 feet or more below the sea floor unless, after application and justification, the well is determined to be incapable of flowing oil or gas. These installations shall be made as required in subparagraphs A and B below within two (2) days after stabilized production is established, and during this period of time the well shall not be left unattended while open to production.*

A. <u>New Wells</u>. *All tubing installations in wells completed after December 1, 1972, shall be equipped with a surface- or other remotely controlled subsurface safety device; provided, that wells with a shut-in tubing pressure of 4,000 psig or greater shall be equipped with a subsurface-controlled subsurface safety device in lieu of a surface- or other remotely controlled subsurface safety device unless a surface- or other remotely controlled subsurface safety device is approved or required. When the shut-in tubing pressure declines below 4,000 psig, a surface- or other remotely controlled subsurface safety device shall be installed when the tubing is first removed and reinstalled.*

B. <u>Existing Wells</u>. *All tubing installations in wells existing on the date of this Order shall be equipped with a surface- or other remotely controlled subsurface safety device when the tubing is first removed and reinstalled after December 1, 1972; provided, that wells with a shut-in tubing pressure of 4,000 psig or greater shall be equipped with a subsurface-controlled subsurface safety device in lieu of a surface- or other remotely controlled subsurface safety device unless a surface- or other remotely controlled subsurface safety device is approved or required. When the shut-in tubing pressure declines below 4,000 psig, a surface- or other remotely controlled subsurface safety device shall be installed when the tubing is first removed and reinstalled.*

Tubing installations in existing wells completed from single-well and multi-well satellite caissons or jackets and sea-floor completions may be equipped with a subsurface-controlled subsurface safety device, in lieu of a surface- or other remotely controlled subsurface safety device, upon application, justification, and approval.

C. <u>Shut-in Wells</u>. *A tubing plug shall be installed in lieu of, or in addition to, other subsurface safety devices if a well has been shut in for a period of six (6) months. Such plugs shall be set at a depth of 100 feet or more below the sea floor. All retrievable plugs installed after the date of this Order shall be of the pump-through type. All wells perforated and completed, but not placed on production, shall be equipped with a subsurface safety device or tubing plug within two (2) days after completion.*

D. <u>Injection Wells</u>. *Subsurface safety devices as required in subparagraphs A and B above shall be installed in all injection wells unless, after application and justification, it is determined that the well is incapable of flowing oil or gas, which condition shall be verified annually.*

2. *<u>Technological Advancement</u>. As technological research, progress, and product improvement result in increased effectiveness of existing safety devices or the development of new devices or systems, such devices or systems may be required or used upon application, justification, and approval. Applications for routine use shall include evidence that the device or system has been field-tested at least once each month for a minimum of six (6) consecutive months, and that each test indicated proper operation.*

3. *<u>Testing and Inspection</u>. Subsurface safety devices shall be designed, adjusted, installed, and maintained to insure reliable operation. During testing and inspection procedures; the well shall not be left unattended while open to production unless a properly operating subsurface safety device has been installed in the well.*

   A. *<u>Surface-Controlled Subsurface Safety Devices</u>. Each surface- or other remotely controlled subsurface safety device installed in a well shall be tested in place for proper operation when installed and thereafter at intervals not exceeding six (6) months. If the device does not operate properly, it shall be removed, repaired, and reinstalled or replaced and tested to insure proper operation.*

   B. *<u>Subsurface-Controlled Subsurface Safety Devices</u>. Each subsurface-controlled subsurface safety device installed in a well shall be removed, inspected, and repaired or adjusted as necessary and reinstalled at intervals not exceeding six (6) months; provided, that such removable devices set in a landing nipple shall be removed, inspected, and repaired or adjusted as necessary and reinstalled at intervals not exceeding twelve (12) months. Each velocity-type device shall be designed to close at a flow rate not to exceed the larger of either 150 percent of, or 200 BFPD above, the most recent well-test rate which equals or exceeds the approved production rate. The above closing flow rate shall not exceed the calculated capacity of the well to produce against a flowing wellhead pressure of 50 psig. Each preset tubing-pressure-actuated device shall be designed to close prior to reduction of the flowing wellhead pressure to 50 psig.*

   C. *<u>Tubing Plugs</u>. A shut-in well equipped with a tubing plug shall be inspected for leakage by opening the well to possible flow at intervals not exceeding six (6) months. If sustained liquid flow exceeds 400 cc/min., or gas flow exceeds 15 cu. ft./min., the plug shall be removed, repaired, and reinstalled or an additional tubing plug installed to prevent leakage.*

4. *Temporary Removal.* *Each wireline- or pumpdown-retrievable subsurface safety device may be removed, without further authority or notice, for a routine operation which does not require approval of a Sundry Notice and Report on Wells (Form 9-331) for a period not to exceed fifteen (15) days. The well shall be clearly identified as being without a subsurface safety device and shall not be left unattended while open to production. The provisions of this paragraph are not applicable to the testing and inspection procedures in paragraph 3 above.*

5. *Additional Protective Equipment.* *All tubing installations made after the date of this Order in which a wireline- or pumpdown-retrievable subsurface safety device is to be installed shall be equipped with a landing nipple, with flow couplings or other protective equipment above and below, to provide for setting of the subsurface safety device. All wells in which a subsurface safety device or tubing plug is installed shall have the tubing-casing annulus packed off above the uppermost open casing perforations. The control system for all surface-controlled subsurface safety devices shall be an integral part of the platform shut-in system, or of an independent remote shut-in system.*

6. *Departures.* *All departures (or waivers) approved prior to the date of this Order are hereby terminated as of December 1, 1972, unless new applications are submitted prior to that date. All such new applications will be considered for approval pursuant to 30 CFR 250.12(b) and the requirements of this Order. All applications for departures shall include a detailed statement of the well conditions, efforts made to overcome any difficulties, and proposed alternate safety measures.*

7. *Emergency Action.* *All tubing installations open to hydrocarbon-bearing zones and not equipped with a subsurface safety device as permitted by this Order shall be clearly identified as not being so equipped, and a subsurface safety device or tubing plug shall be available at the field location. In the event of an emergency, such as an impending hurricane, such device or plug shall be promptly installed within the limits of practicability, due consideration being given to personnel safety.*

8. *Records.* *The operator shall maintain the following records for a minimum period of one year for each subsurface safety device and tubing plug installed, which records shall be available to any authorized representative of the Geological Survey.*

   A. *Field Records.* *Individual well records shall be maintained at or near the field and shall include, as a minimum, the following information:*

(1) A record which will give design and other information; i.e., make, model, type, spacers, bean and spring size, pressure, etc.

(2) Verification of assembly by a qualified person in charge of installing the device and installation date.

(3) Verification of setting depth and all operational tests as required in this Order.

(4) Removal date, reason for removal, and reinstallation date.

(5) A record of all modifications of design in the field.

(6) All mechanical failures or malfunctions, including sand-cutting, of such devices, with notation as to cause or probable cause.

(7) Verification that a failure report was submitted.

B. Other Records. The following records, as a minimum, shall be maintained at the operator's office:

(1) Verified design information of subsurface-controlled subsurface safety devices for the individual well.

(2) Verification of assembly and installation according to design information.

(3) All failure reports.

(4) All laboratory analysis reports of failed or damaged parts.

(5) Quarterly failure-analysis report.

9. Reports. Well completion reports (Form 9-330) and any subsequent reports of workover (Form 9-331) shall include the type and the depth of the subsurface safety devices and tubing plugs installed in the well or indicate that a departure has been granted.

To establish a failure-reporting and corrective-action program as a basis for reliability and quality control, each operator shall submit a quarterly failure-analysis report to the office of the Supervisor, identifying mechanical failures by lease and well, make and model, cause or probable cause of failure, and action taken to correct the failure. The reporting period shall begin the first day of the month following the date of this

Order. The reports shall be submitted by February 28, May 31, August 31, and November 30 for the periods ending January 31, April 30, July 31, and October 31 of each year.

Robert F. Evans

Robert F. Evans
Supervisor

Approved: June 5, 1972

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

ATTACH. G, p.22

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

PROCEDURE FOR COMPLETION OF OIL AND GAS WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.92. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Wellhead Equipment and Testing Procedures.

   A. Wellhead Equipment. All completed wells shall be equipped with casingheads, wellhead fittings, valves and connections with a rated working pressure equal to or greater than the surface shut-in pressure of the well. Connections and valves shall be designed and installed to permit fluid to be pumped between any two strings of casing. Two master valves shall be installed on the tubing in wells with a surface pressure in excess of five thousand pounds per square inch. All wellhead connections shall be assembled and tested, prior to installation, by a fluid pressure which shall be equal to the rated test pressure of the fitting to be installed.

   B. Testing Procedure. Any wells showing sustained pressure on the casinghead, or leaking gas or oil between the production casing and the next larger casing string, shall be tested in the following manner: The well shall be killed with water or mud and pump pressure applied. Should the pressure at the casinghead reflect the applied pressure, the casing shall be condemned. After corrective measures have been taken, the casing shall be tested in the same manner. This testing procedure shall be used when the origin of the pressure cannot be determined otherwise.

2. Storm Choke. All completed wells shall meet the requirements prescribed in OCS Order No. 5.

3. *Procedures for Multiple or Tubingless Completions.*

A. *Multiple Completions.*

(1) Information shall be submitted on, or attached to, Form 9-331 showing top and bottom of all zones proposed for completion or alternate completion, including a partial electric log and a diagrammatic sketch showing such zones and equipment to be used.

(2) When zones approved for multiple completion become intercommunicated the lessee shall immediately repair and separate the zones after approval is obtained.

B. *Tubingless Completions.*

(1) All tubing strings in a multiple completed well shall be run to the same depth below the deepest producible zone.

(2) The tubing string(s) shall be new pipe and cemented with a sufficient volume to extend a minimum of 500 feet above the uppermost producible zone.

(3) A temperature or cement bond log shall be run in all tubingless completion wells where lost circulation or other unusual circumstances occur during the cementing operations.

(4) Information shall be submitted on, or attached to, Form 9-331 showing the top and bottom of all zones proposed for completion or alternate completion, including a partial electric log and a diagrammatic sketch showing such zones and equipment to be used.

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
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BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

POLLUTION AND WASTE DISPOSAL

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.43. Section 250.43 provides as follows:

(a) The lessee shall not pollute land or water or damage the aquatic life of the sea or allow extraneous matter to enter and damage any mineral- or water-bearing formation. The lessee shall dispose of all liquid and non-liquid waste materials as prescribed by the supervisor. All spills or leakage of oil or waste materials shall be recorded by the lessee and, upon request of the supervisor, shall be reported to him. All spills or leakage of a substantial size or quantity, as defined by the supervisor, and those of any size or quantity which cannot be immediately controlled also shall be reported by the lessee without delay to the supervisor and to the Coast Guard and the Regional Director of the Federal Water Pollution Control Administration. All spills or leakage of oil or waste materials of a size or quantity specified by the designee under the pollution contingency plan shall also be reported by the lessee without delay to such designee.

(b) If the waters of the sea are polluted by the drilling or production operations conducted by or on behalf of the lessee, and such pollution damages or threatens to damage aquatic life, wildlife, or public or private property, the control and total removal of the pollutant, wheresoever found, proximately resulting therefrom shall be at the expense of the lessee. Upon failure of the lessee to control and remove the pollutant the supervisor, in cooperation with other appropriate agencies of the Federal, State and local governments, or in cooperation with the lessee, or both, shall have the right to accomplish the control and removal of the pollutant in accordance with any established contingency plan for combating oil spills or by other means at the cost of the lessee. Such action shall not relieve the lessee of any responsibility as provided herein.

(c) The lessee's liability to third parties, other than for cleaning up the pollutant in accordance with subsection (b) above, shall be governed by applicable law.

The operator shall comply with the following requirements. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. Pollution Prevention. In the conduct of all oil, gas and sulphur operations, the operator shall prevent pollution of the waters of the Gulf of Mexico. The operator shall comply with the following pollution prevention requirements:

A. Liquid Disposal.

(1) Oil in any form shall not be disposed of into the waters of the Gulf.

(2) Liquid waste materials containing substances which may be harmful to aquatic life or wildlife, or injurious in any manner to life or property, shall be treated to avoid disposal of harmful substances into the waters of the Gulf.

(3) Drilling mud containing oil shall not be disposed of into the Gulf. Drilling mud containing toxic substances shall be neutralized prior to disposal.

B. Solid Waste Disposal.

(1) Drill cuttings, sand, and other solids containing oil shall not be disposed of into the Gulf unless the oil has been removed.

(2) Mud containers and other solid waste materials shall be incincerated or transported to shore for disposal.

C. Production Facilities.

(1) All production facilities, such as separators, tanks, treaters, and other equipment, shall be such as are necessary to control the maximum anticipated pressures and production of oil, gas, and sulphur, and shall be maintained at all times in a manner necessary to prevent pollution.

(2) *All platforms and structures shall be curbed and connected by drains to a collecting tank or sump unless drip pans, or equivalents, are placed under equipment, from which a pollutant may spill into the Gulf, and piped to a tank or sump.*

(3) *The operator's personnel shall be thoroughly instructed in the techniques of equipment maintenance and operation for the prevention of pollution. Non-operator personnel shall be informed in writing, prior to executing contracts, of the operator's obligations to prevent pollution.*

2. *Inspections and Reports. The operator shall comply with the following pollution inspection and reporting requirements:*

A. *Pollution Inspections.*

(1) *Manned facilities shall be inspected daily.*

(2) *Unattended facilities, including those equipped with remote control and monitoring systems, shall be inspected at frequent intervals. The district engineer may prescribe the frequency of inspections for these facilities.*

B. *Pollution Reports.*

(1) *All spills or leakage of oil and liquid pollutants shall be recorded showing the cause, size of spill, and action taken, and the record shall be maintained and available for inspection by the supervisor. All spills or leakage of less than 15 barrels shall be reported to the district engineer when requested by him.*

(2) *All spills or leakage of oil and liquid pollutants of 15 to 50 barrels shall be reported orally to the district engineer without delay and shall be confirmed in writing.*

(3) *All spills or leakage of oil and liquid pollutants of a substantial size or quantity, which is defined as more than 50 barrels, and those of any size or quantity which cannot be immediately controlled, shall be reported orally without delay to the supervisor, the district engineer, the Coast Guard, and the Regional Director, Federal Water Pollution Control Administration. All oral reports shall be confirmed in writing.*

(4) Operators shall notify each other upon observation of equipment malfunction or pollution resulting from another's operation.

3. Control and Removal.

A. Corrective Action. Immediate corrective action shall be taken in all cases where pollution has occurred. Each operator shall have an emergency plan for initiating corrective action to control and remove pollution and such plan shall be filed with the supervisor. Corrective action taken under the plan shall be subject to modification when directed by the supervisor.

B. Equipment. Standby pollution control equipment shall be maintained by or shall be immediately available to each operator at a land base location. This equipment shall include containment booms, skimming apparatus, and approved chemical dispersants and shall be available prior to the commencement of operations. The equipment shall be regularly inspected and maintained in good condition for use. The equipment and the location of land bases shall be approved by the supervisor. The operator shall notify the supervisor of the location at which such equipment is located for operations conducted on or for each lease. All changes in location and equipment maintained at each location shall be approved by the supervisor.

Robert F. Evans
Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland
Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
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BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

APPROVAL PROCEDURE FOR INSTALLATION AND OPERATION OF PLATFORMS, FIXED AND MOBILE STRUCTURES, AND ARTIFICIAL ISLANDS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.19(a). Section 250.19(a) provides as follows:

> (a) The Supervisor is authorized to approve the design, other features, and plan of installation of all platforms, fixed structures, and artificial islands as a condition of the granting of a right of use or easement under Paragraphs (a) and (b) of Section 250.18 or authorized under any lease issued or maintained under the Act.

The operator shall be responsible for compliance with the requirements of this Order in the installation and operation of all platforms, fixed and mobile structures, and artificial islands, including all facilities installed on a platform or structure whether or not operated or owned by the operator. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. The following requirements are applicable to all platforms approved and installed subsequent to the effective date of this Order, and to all platforms when structural and equipment modifications are to be made:

   A. General Design. The design of platforms, fixed structures, and artificial islands shall include consideration of such factors as water depth, surface and subsurface soil conditions, wave and current forces, wind forces, total equipment weight, and other pertinent geological, geographical, environmental, and operational conditions.

B. <u>Application</u>. *The operator shall submit, in duplicate, the following to the appropriate District Office for approval:*

(1) <u>Design Features</u>. Information relative to design features on an 8" x 10½" plat or plats showing the platform dimensions, plan and two elevations, number and location of well slots, and water depth. In addition, the plat shall include:

(a) Nominal size and thickness range of piling.

(b) Nominal size and thickness range of jacket column leg.

(c) Nominal size and thickness range of deck column leg.

(d) Design piling penetration.

(e) Maximum bearing and lateral load per pile in tons.

(f) Identification data which shall be the lease number, block number, area, and operator.

(g) The following certification signed and dated with the title of the company representative:

"<u>Operator</u> certifies that this platform has been certified by a registered professional engineer and that the structure will be constructed, operated, and maintained as described in the application, and any approved modification thereto. Certified plans are on file at ________________________."

(2) <u>Non-design Features</u>. Information relative to non-design features including the following:

(a) Primary use intended, including drilling, production of oil and gas, sulphur, or salt.

(b) Personnel and personnel transfer facilities including living quarters, boat landings, and heliport.

(c) Type of deck, such as steel or wood, and whether coated with protective material.

(d) Method of protection from corrosion.

(e) Production facilities including separators, treaters, storage tanks, compressors, line pumps, and metering devices, except that when initially designed and utilized for drilling, this information may be submitted prior to installation.

(f) Safety and pollution control equipment and features.

(g) Other information when required.

C. Certified Plan. Detailed structural plans certified by a registered professional engineer shall be on file and maintained by the operator or his designee.

2. Safety and Pollution Control Equipment and Procedures.

A. The following requirements shall apply to all platforms. Operators of platforms installed prior to the effective date of this Order shall comply with the requirements of subparagraphs (1)(a) through (f), (2), and (3) within three months, with subparagraphs (1)(g) and (4) within six months, and with subparagraphs (5), (6), (7), (8), and (9) within one year, from the effective date of this Order.

(1) The following shut-in devices shall be installed and maintained in an operating condition on all pressurized vessels and water separation facilities when such vessels and separation facilities are in service. The operator shall submit records to the appropriate District Office semi-annually showing the present status and past history of each device including dates and details of inspection, testing, repairing, adjustment, and reinstallation.

(a) All separators shall be equipped with high-low pressure shut-in sensors, low level shut-in controls, and a relief valve. High liquid level control devices shall be installed when the vessel can discharge to a flare.

(b) All pressure surge tanks shall be equipped with a high and low pressure shut-in sensor, a high level shut-in control, flare line, and relief valve.

(c) Atmospheric surge tanks shall be equipped with a high level shut-in sensor.

(d) All other hydrocarbon handling pressure vessels shall be equipped with high-low pressure shut-in sensors, high-low level shut-in controls, and relief valves, unless determined to be otherwise protected.

(e) Pilot-operated pressure relief valves shall be equipped to permit testing with an external pressure source. Spring-loaded pressure relief valves shall either be bench-tested or equipped to permit testing with an external pressure source. A relief valve shall be set no higher than the designed working pressure of the vessel. The high pressure shut-in sensor shall be set no higher than 5% below the rated or designed working pressure and the low pressure shut-in sensor shall be set no lower than 10% below the lowest pressure in the operating pressure range on all vessels with a rated or designed working pressure of more than 400 psi. On lower pressure vessels the above percentages shall be used as guidelines for sensor settings considering pressure and operating conditions involved; except that sensor settings shall not be within 5 psi of the rated or designed working pressure or the lowest pressure in the operating pressure range.

(f) All sensors shall be equipped to permit testing with an external pressure source.

(g) All flare lines shall be equipped with a scrubber or similar separation equipment.

(2) The following remote and local automatic shut-in devices shall be installed and maintained in an operating condition at all times when the affected well (or wells) is producing. The operator shall submit records to the appropriate District Office semi-annually showing the present status and past history of each such device including dates and details of inspection, testing, repairing, adjustment, and reinstallation.

(a) All wellhead assemblies shall be equipped with an automatic fail-close valve. Automatic safety valves temporarily out of service shall be flagged.

(b) All flowlines from wellheads shall be equipped with high-low pressure sensors located close to the wellhead. The pressure sensors shall be set to activate the wellhead valve in the event of abnormal pressures in the flowline.

(c) All headers shall be equipped with check valves on the individual flowlines. The flowline and valves from each well located upstream of, and including, the header valves shall withstand the shut-in pressure of that well, unless protected by a relief valve with connections to bypass the header. If there is an inlet valve to a separator, the valve, flowline, and all equipment upstream of the valve shall also withstand shut-in wellhead pressure, unless protected by a relief valve with connections to bypass the header.

(d) All pneumatic shut-in control lines shall be equipped with fusible material at strategic points.

(e) Remote shut-in controls shall be located on the helicopter deck and all exit stairway landings, including at least one on each boat landing. These controls shall be quick-opening valves.

(f) All pressure sensors shall be tested for proper pressure settings monthly for at least four months. At such time as the monthly results are consistent, a quarterly test shall be required for at least one year. If these results are consistent, a longer period of time between testing may then be approved by the Supervisor. In the event any testing sequence reveals inconsistent results, the monthly testing sequence shall be reinstituted. Results of all tests shall be recorded and maintained in the field.

(g) All automatic wellhead safety valves shall be tested for operation weekly. All automatic wellhead safety valves shall be tested for holding pressure monthly. If these results are consistent, a longer period of time between pressure tests, not to exceed quarterly, may then be approved by the Supervisor. In the event that any pressure testing sequence, exceeding monthly, reveals inconsistent results, the monthly testing sequence shall be reinstituted. Results of all tests shall be recorded and maintained in the field.

(h) Check valves shall be tested for holding pressure monthly for at least four months. At such time as the monthly results are satisfactory, a quarterly test shall be required for at least one year. If these results are consistent, a longer period of time between testing may then be approved by the Supervisor. In the event any testing sequence reveals inconsistent results, the monthly testing sequence shall be reinstituted. Results of all tests shall be recorded and maintained in the field.

(i) A complete testing and inspection of the safety system shall be witnessed by Geological Survey representatives at the time production is commenced. Thereafter, the operator shall arrange for a test every six months. The test shall be conducted when it can be witnessed by Geological Survey representatives.

(j) A standard procedure for testing of safety equipment shall be prepared and posted in a prominent place on the platform.

(3) Curbs, gutters, and drains shall be constructed in all deck areas in a manner necessary to collect all contaminants, unless drip pans or equivalent are placed under equipment and piped to a sump which will automatically maintain the oil at a level sufficient to prevent discharge of oil into the Gulf waters. Alternate methods to obtain the same results will be acceptable. These systems shall not permit spilled oil to flow into the wellhead area.

(4) An auxiliary electrical power supply shall be installed to provide emergency power capable of operating all electrical equipment required to maintain safety of operation in the event the primary electrical power supply fails.

(5) The following requirements shall apply to the handling and disposal of all produced waste water discharged into the Gulf of Mexico. The disposal of waste water other than into the Gulf waters shall have the method and location approved by the Supervisor.

(a) Water discharged shall not create conditions which will adversely affect the public health or the use of the waters for the propagation of aquatic life, recreation, navigation, or other legitimate uses.

(b) Waste water disposal systems shall be designed and maintained to reduce the oil content of the disposed water to an average of not more than fifty ppm. An effluent sampling station shall be located at a point prior to discharge into the receiving waters where a representative sample of the treated effluent can be obtained. On one day each month four effluent samples shall be taken within a 24-hour period and determinations shall be made on the temperature, suspended solids, settleable solids, pH, total oil content, and volume of sample obtained.

All samples shall be taken and all analyses for oil content shall be performed in accordance with the American Society for Testing and Materials test D1340, "Oily Matter in Industrial Waste Water". The Supervisor may approve different methods for determination of oil content if the method to be used is indicated to be reliable. No effluent containing in excess of one hundred ppm of total oil content shall be discharged into the Gulf of Mexico. A written report of the results shall be furnished to the Regional Office annually. The report shall contain dates, time and location of sample, volumes of waste discharge on the date of sampling in barrels per day, and the results of the specific analysis and physical observations.

(6) A firefighting system shall be installed and maintained in an operating condition in accordance with the following:

(a) A fixed automatic water spray system shall be installed in all inadequately ventilated wellhead areas as these areas are defined in Paragraph 9 API RP 500A. These systems shall be installed in accordance with the most current edition of National Fire Protection Association's Pamphlet No. 15.

(b) A firewater system of rigid pipe with fire hose stations shall be installed and may include a fixed water spray system. Such a system shall be installed in a manner necessary to provide needed protection in areas where production handling equipment is located. A firefighting system using chemicals may be considered for installation in certain platform areas in lieu of a firewater system in that area, if determined to provide equivalent fire protection control.

(c) Pumps for the firewater systems shall be inspected and test-operated weekly. A record of the tests shall be maintained in the field and submitted semi-annually to the appropriate District Office. An alternate fuel or power source shall be installed to provide continued pump operation during platform shutdown unless an alternate firefighting system is provided.

(d) Portable fire extinguishers shall be located in the living quarters and in other strategic areas.

(e) A diagram of the firefighting system showing the location of all equipment shall be posted in a prominent place on the platform and a copy submitted to the appropriate District Office.

(7) An automatic gas detector and alarm system shall be installed and maintained in an operating condition in accordance with the following:

(a) Gas detection systems shall be installed in all enclosed areas containing gas handling facilities or equipment and in other enclosed areas which are classified as hazardous areas as defined in API RP 500 and the most current edition of the National Electric Code.

(b) All gas detection systems shall be capable of continuously monitoring for the presence of combustible gas in the areas in which the detection devices are located.

(c) The central control shall be capable of giving an alarm at some point below the lower explosive limit of 1.3% as shown in the Bureau of Mines Bulletin No. 503. This low level shall be for alarm purposes only.

(d) A high level setting of not more than 4.9% shall be used for shut-in sequences and the operation of emergency equipment.

(e) An application for the installation and maintenance of any gas detection system shall be filed with the appropriate District Office for approval. The application shall include the following:

(i) Type, location, and number of detection or sampling heads.

(ii) Cycling, noncycling, and frequency information.

(iii) Type and kind of alarm including emergency equipment to be activated.

(iv) *Method used for detection of combustible gas.*

(v) *Method and frequency of calibration.*

(vi) *A diagram of the gas detection system.*

(vii) *Other pertinent information.*

(f) *A diagram of the gas detection system showing the location of all gas detection points shall be posted in a prominent place on the platform.*

(8) *The following requirements shall be applicable to all electrical equipment and systems installed:*

(a) *All engines shall be equipped with low-tension ignition systems containing rigid connections and shielded wiring which shall prevent the release of sufficient electrical energy under normal or abnormal conditions to cause ignition of a combustible mixture.*

(b) *All electrical generators, motors, and lighting systems shall be installed, protected, and maintained in accordance with the most current edition of the National Electric Code and API RP 500A and B, as appropriate.*

(c) *Marine-armored cable or metal-clad cable may be substituted for wire in conduit in any area.*

(9) *Sewage disposal systems shall be installed and used in all cases where sewage is discharged into the Gulf of Mexico. Sewage is defined as human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes. Following sewage treatment, the effluent shall contain 50 ppm or less of biochemical oxygen demand (BOD), 150 ppm or less of suspended solids, and shall have a minimum chlorine residual of 1.0 mg/liter after a minimum retention time of fifteen minutes.*

B. *The requirements of subparagraphs 2.A(3), (4), (8), and (9) shall apply to all mobile drilling structures used to conduct drilling or workover operations on Federal leases in the Gulf of Mexico.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: October 30, 1970

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

APPROVAL PROCEDURE FOR OIL AND GAS PIPELINES

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.19(b). Section 250.19(b) provides as follows:

> *(b) The Supervisor is authorized to approve the design, other features, and plan of installation of all pipelines for which a right of use or easement has been granted under Paragraph (c) of Section 250.18 or authorized under any lease issued or maintained under the Act, including those portions of such lines which extend onto or traverse areas other than the Outer Continental Shelf.*

The operator shall comply with the following requirements. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. *General Design. All pipelines shall be designed and maintained in accordance with the following:*

   A. *The operator shall be responsible for the installation of the following control devices on all oil and gas pipelines connected to a platform including pipelines which are not operated or owned by the operator. Operators of platforms installed prior to the effective date of this Order shall comply with the requirements of subparagraphs (1) and (2) within six months of the effective date of this Order. The operator shall submit records semi-annually showing the present status and past history of each device, including dates and details of inspection, testing, repairing, adjustment, and reinstallation.*

      (1) All oil and gas pipelines leaving a platform receiving production from the platform shall be equipped with a high-low pressure sensor to directly or indirectly shut-in the wells on the platform.

(2) (a) All oil and gas pipelines delivering production to production facilities on a platform shall be equipped with an automatic shut-in valve connected to the platform's automatic and remote shut-in system.

(b) All oil and gas pipelines coming onto a platform shall be equipped with a check valve to avoid backflow.

(c) Any oil or gas pipelines crossing a platform which do not deliver production to the platform, but which may or may not receive production from the platform, shall be equipped with high-low pressure sensors to activate an automatic shut-in valve to be located in the upstream portion of the pipeline at the platform. This automatic shut-in valve shall be connected to either the platform automatic and remote shut-in system or to an independent remote shut-in system.

(d) All pipeline pumps shall be equipped with high-low pressure shut-in devices.

B. All pipelines shall be protected from loss of metal by corrosion that would endanger the strength and safety of the lines either by providing extra metal for corrosion allowance, or by some means of preventing loss of metal such as protective coatings or cathodic protection.

C. All pipelines shall be installed and maintained to be compatible with trawling operations and other uses.

D. All pipelines shall be hydrostatically tested to 1.25 times the designed working pressure for a minimum of 2 hours prior to placing the line in service.

E. All pipelines shall be maintained in good operating condition at all times and inspected monthly for indication of leakage using aircraft, floating equipment, or other methods. Records of these inspections including the date, methods, and results of each inspection shall be maintained by the pipeline operator and submitted annually by April 1. The pipeline operator shall submit records indicating the cause, effect, and remedial action taken regarding all pipeline leaks within one week following each such occurrence.

F. *All pipelines shall be designed to be protected against water currents, storm scouring, soft bottoms, and other environmental factors.*

2. *Application. The operator shall submit in duplicate the following to the Supervisor for approval:*

   A. *Drawing on 8" x 10½" plat or plats showing the major features and other pertinent data including: (1) water depth, (2) route, (3) location, (4) length, (5) connecting facilities, (6) size, and (7) burial depth, if buried.*

   B. *A schematic drawing showing the following pipeline safety equipment and the manner in which the equipment functions: (1) high-low pressure sensors, (2) automatic shut-in valves, and (3) check valves.*

   C. *General information concerning the pipeline including the following:*

      (1) *Product or products to be transported by the pipeline.*

      (2) *Size, weight, and grade of the pipe.*

      (3) *Length of line.*

      (4) *Maximum water depth.*

      (5) *Type or types of corrosion protection.*

      (6) *Description of protective coating.*

      (7) *Bulk specific gravity of line (with the line empty).*

      (8) *Anticipated gravity or density of the product or products.*

      (9) *Design working pressure and capacity.*

      (10) *Maximum working pressure and capacity.*

      (11) *Hydrostatic pressure and hold time to which the line will be tested after installation.*

      (12) *Size and location of pumps and prime movers.*

      (13) *Any other pertinent information as the Supervisor may prescribe.*

3. *<u>Completion Report</u>. The operator shall notify the Supervisor when installation of the pipeline is completed and submit a drawing on 8" x 10½" plats showing the location of the line as installed, accompanied by all hydrostatic test data including procedure, test pressure, hold time, and results.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: October 30, 1970

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

ATTACH. G, p.43

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL SULPHUR LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

SULPHUR DRILLING PROCEDURES OFF LOUISIANA AND TEXAS

This Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.34, 250.41, and 250.91. All exploratory core holes for sulphur and all sulphur development wells shall be drilled in accordance with the provisions of this Order, except that development wells shall be drilled in accordance with field rules when established by the supervisor. Each Application to Drill (Form 9-331C) shall include all information required under 30 CFR 250.91 and the integrated casing, cementing, mud, and blowout prevention program for the well. The operator shall comply with the following requirements. Any departures from the requirements specified in this Order must be approved pursuant to 30 CFR 250.12(b).

1. *Well Casing and Cementing. All wells shall be cased and cemented in accordance with the requirements of 30 CFR 250.41(a)(1). Special consideration to casing design shall be given to compensate for effects caused by subsidence, corrosion, and temperature variation. All depths refer to true vertical depth (TVD).*

   A. *Drive or Structural Casing. This casing shall be set by drilling, driving, or jetting to a minimum depth of 100 feet below the Gulf floor, or to such greater depth required to support unconsolidated deposits and to provide hole stability for initial drilling operations. If drilled in, the drilling fluid shall be a type that will not pollute the Gulf, and a quantity of cement sufficient to fill the annular space back to the Gulf floor must be used.*

   B. *Conductor Casing. This casing shall be set and cemented before drilling into shallow formations known to contain hydrocarbons or, if unknown, upon encountering such formations. Conductor casing shall extend to a depth of not less than 350 feet nor more than 750 feet below the Gulf floor. A quantity of cement sufficient to fill*

the annular space back to the Gulf floor must be used. The cement may be washed out or displaced to a depth of 40 feet below the Gulf floor to facilitate casing removal upon well abandonment.

C. *Caprock Casing. This casing shall be set at the top of the caprock and be cemented with a quantity of cement sufficient to fill the annular space back to the Gulf floor. Stage cementing or other cementing method shall be used to insure cement returns to the Gulf floor.*

2. *Blowout Prevention Equipment. Blowout preventers and related well control equipment shall be installed, used, and tested in a manner necessary to prevent blowouts. Prior to drilling below the conductor casing, blowout prevention equipment shall be installed and maintained ready for use until drilling operations are completed, as follows:*

A. *Conductor Casing. Before drilling below this string, at least one remotely controlled bag-type blowout preventer and equipment for circulating the drilling fluid to the drilling structure or vessel shall be installed. To avoid formation fracturing from complete shut-in of the well, a large diameter pipe with control valves shall be installed on the conductor casing below the blowout preventer so as to permit the diversion of hydrocarbons and other fluids; except that when the blowout preventer assembly is on the Gulf floor, the choke and kill lines shall be equipped to permit the diversion of hydrocarbons and other fluids.*

B. *Caprock Casing. Before drilling below this string, the blowout prevention equipment shall include a minimum of: (1) three remotely controlled, hydraulically operated, blowout preventers with a working pressure which exceeds the maximum anticipated surface pressure, including one equipped with pipe rams, one with blind rams, and one bag-type; (2) a drilling spool with side outlets, if side outlets are not provided in the blowout preventer body; (3) a choke manifold; (4) a kill line; and (5) a fill-up line.*

C. *Testing.* *Ram-type blowout preventers and related control equipment shall be tested with water to the rated working pressure of the stack assembly, or to the working pressure of the casing, whichever is the lesser, (1) when installed; (2) before drilling out after each string of casing is set; (3) not less than once each week while drilling; and (4) following repairs that require disconnecting a pressure seal in the assembly. The bag-type blowout preventer shall be tested to 70 percent of the above pressure requirements.*

While drill pipe is in use ram-type blowout preventers shall be actuated to test proper functioning once each day. The bag-type blowout preventer shall be actuated on the drill pipe once each week. Accumulators or accumulators and pumps shall maintain a pressure capacity reserve at all times to provide for repeated operation of hydraulic preventers. A blowout prevention drill shall be conducted weekly for each drilling crew to insure that all equipment is operational and that crews are properly trained to carry out emergency duties. All blowout preventer tests and crew drills shall be recorded on the driller's log.

D. *Other Equipment.* *A drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. Separate valves shall be maintained on the rig floor to fit all pipe in the drill string. A Kelly cock shall be installed below the swivel.*

3) *Mud Program - General.* *The characteristics, use, and testing of drilling mud and the conduct of related drilling procedures shall be such as are necessary to prevent the blowout of any well. Quantities of mud materials sufficient to insure well control shall be maintained readily accessible for use at all times. The following mud control and testing equipment requirements are applicable to operations conducted prior to drilling below the caprock casing.*

A. *Mud Control.* *Before starting out of the hole with drill pipe, the mud shall be circulated with the drill pipe just off bottom until the mud is properly conditioned. When coming out of the hole with drill pipe, the annulus shall be filled with mud before the mud level drops below 100 feet, and a mechanical device for measuring the amount of mud required to fill the hole shall be utilized. The volume of mud required to fill the hole shall be watched,*

and any time there is an indication of swabbing, or influx of formation fluids, the drill pipe shall be run to bottom, and the mud properly conditioned. The mud shall not be circulated and conditioned except on or near bottom, unless well conditions prevent running the pipe to bottom.

B. *<u>Mud Testing and Equipment</u>. Mud testing equipment shall be maintained on the drilling platform at all times, and mud tests shall be performed daily, or more frequently as conditions warrant.*

The following mud system monitoring equipment must be installed (with derrick floor indicators) and used throughout the period of drilling after setting and cementing the conductor casing:

(1) *Recording mud pit level indicator to determine mud pit volume gains and losses. This indicator shall include a visual or audio warning device.*

(2) *Mud volume measuring device for accurately determining mud volumes required to fill the hole on trips.*

(3) *Mud return indicator to determine that returns essentially equal the pump discharge rate.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved: August 28, 1969

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

INTERIM OIL AND GAS PRODUCTION RATES

This Interim Order is established pursuant to the authority prescribed in 30 CFR 250.11 and in accordance with 30 CFR 250.16 and supersedes Interim OCS Order No. 11, dated December 11, 1970, and the first and second revisions thereof, dated February 11, 1971, and March 29, 1971, respectively. The provisions of this Interim Order and the maximum production rates heretofore approved under Interim Order No. 11, dated December 11, 1970, will remain in full force and effect until superseded, amended, or terminated. 30 CFR 250.16 provides as follows:

> *Well potentials and permissible flow. The supervisor is authorized to specify the time and method for determining the potential capacity of any well and to fix, after appropriate notice, the permissible production of any such well that may be produced when such action is necessary to prevent waste or to conform with such proration rules, schedules, or procedures as may be established by the Secretary.*

In accordance with the notice appearing in the Federal Register, dated December 5, 1970 (35 F.R. 18559), the provisions of this Order are applicable to all oil and gas wells located on the Outer Continental Shelf of the Gulf of Mexico off the State of Texas and the undisputed areas off the State of Louisiana; provided, however, this order shall not apply to any wells on oil and gas leases situated landward of the line, or transected by the line, described in paragraph 3 of the Supplemental Decree entered December 20, 1971, in United States v. Louisiana, S. Ct. No. 9, Original (40 L.W. 3287). Any departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12 (b).

1. *Maximum Production Rates.*

A. *Producible Wells. Effective May 1, 1972, all producible oil and gas wells and reservoirs may be produced at daily rates not to exceed the Maximum Efficient Rate (MER), subject to the limitations set forth in paragraph 5 below.*

B. *New Completions and Recompletions. New oil and gas well completions and recompletions shall be produced at a rate established by the Supervisor. A testing period not to exceed 30 days will be allowed prior to setting the maximum production rate for the well. At the end of the testing period, the operator shall submit a detailed determination of the MER justifying a proposed maximum rate of production for the Supervisor's approval. The initial production test of all completions and recompletions may be witnessed by a representative of the Supervisor.*

2. *Definition of MER. The MER is defined as that rate for each reservoir and each well which, if exceeded, would lead to avoidable underground waste through loss of ultimate recovery of oil and gas from that reservoir. It is dependent on the recovery mechanism operative for the current producing period, and is based on engineering and geological information.*

3. *Determination of MER. On or before May 1, 1972, each operator shall submit reports, for approval by the Supervisor, showing the operator's estimate of the MER for each oil and gas well and reservoir on those leases in the area removed from dispute in United States v. Louisiana, S. Ct. No. 9, Original, by entry of the Supplemental Decree of December 20, 1971, in that litigation (40 L.W. 3287). Reports shall be identified by the name of the field, the OCS lease number, the well number, and the designation and depth of the productive zone. As soon as available and prior to July 1, 1972, each operator shall submit the technical information and methods used to determine the MER applicable to each well and reservoir.*

Revisions in the operator's estimate of the MER for oil and gas wells and reservoirs located on leases subject to this Interim Order shall be submitted to the Supervisor for approval.

4. *Reports. Each operator shall submit the following reports for each lease separately to the Regional Office. Initial reports for those leases in the area removed from dispute, referred to in Paragraph 3 above, shall be for the month of April 1972 for the reports required in A, C, and D, below, and for the quarter ending April 1, 1972, for the report required in B below.*

A. *A monthly well potential report on a form identical to the Louisiana Department of Conservation Form DM-1R. This report shall be submitted for each month by the 10th day of each succeeding month.*

B. *A gas well deliverability test report on a form identical to the Louisiana Department of Conservation Form DT-1, shall be submitted by January 1, April 1, July 1, and October 1.*

C. *A monthly producer's crude oil and/or condensate report on a form identical to Louisiana Department of Conservation Form R-1. This report shall be submitted for each month by the 25th day of each succeeding month.*

D. *A monthly producer's natural gas report on a form identical to Louisiana Department of Conservation Form R-5P. This report shall be submitted for each month by the last day of each succeeding month.*

5. *Limitations on Production.*

A. *Production rates shall not result in venting or flaring of gas in violation of the Operating Regulations in 30 CFR 250.30.*

B. *In order to provide safe operating conditions and prevent pollution, oil and gas production rates shall not exceed the operating capacity of production, transportation, and storage facilities, including, but not limited to, separators, dehydrators, compressors, surge tanks, and pipelines. All producing operations shall be in accordance with the provisions of OCS Orders Nos. 5, 7, 8 and 9. Production rates shall be maintained at a level to permit efficient operation of subsurface safety devices.*

Robert F. Evans

Robert F. Evans
Supervisor

Approved:

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
BRANCH OF OIL AND GAS OPERATIONS
GULF OF MEXICO AREA

NOTICE TO LESSEES AND OPERATORS OF FEDERAL LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO AREA

PUBLIC INSPECTION OF RECORDS

is Interim Order is established pursuant to the authority prescribed in CFR 250.11 and in accordance with 30 CFR 250.97 and 43 CFR 2.2. Section).97 of 30 CFR provides as follows:

> Public Inspection of Records. Geological and geophysical interpretations, maps, and data required to be submitted under this part shall not be available for public inspection without the consent of the lessee so long as the lease remains in effect or until such time as the supervisor determines that release of such information is required and necessary for the proper development of the field or area.

:tion 2.2 of 43 CFR provides in part as follows.

> Determinations as to Availability of Records. (a) Section 552 of Title 5, U.S. Code, as amended by Public Law 90-23 (the act codifying the "Public Information Act") requires that identifiable agency records be made available for inspection. Subsection (b)[1] of section 552 exempts several categories of records from the general requirement but does not require the withholding from inspection of all records which may fall within the categories exempted. Accordingly, no request made of a field office to inspect a record shall be denied unless the head of the office or such higher field authority as the head of the bureau may designate shall determine (1) that the record falls within one or more of

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ıbsection (b) of section 552 provides that:
›) This section does not apply to matters that are--
***
ł) Trade secrets and commercial or financial information obtained
›m a person and privileged or confidential;
***
›) Geological and geophysical information and data, including maps,
ıcerning wells.

the categories exempted and (2) either that disclosure is prohibited by statute or Executive Order or that sound grounds exist which require the invocation of the exemption. A request to inspect a record located in the headquarters office or a bureau shall not be denied except on the basis of a similar determination made by the head of the bureau or his designee, and a request made to inspect a record located in a major organizational unit of the Office of the Secretary shall not be denied except on the basis of a similar determination by the head of that unit. Officers and employees of the Department shall be guided by the "Attorney General's Memorandum on the Public Information Section of the Administrative Procedure Act" of June 1967.

(b) An applicant may appeal from a determination that a record is not available for inspection to the Solicitor of the Department of the Interior, who may exercise all of the authority of the Secretary of the Interior in this regard. The Deputy Solicitor may decide such appeals and may exercise all of the authority of the Secretary in this regard.

The operator shall comply with the requirements of this Order. Any departures from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 250.12(b).

1. Availability of Records Filed on or after December 1, 1970. It has been determined that certain records pertaining to leases and wells in the Outer Continental Shelf and submitted under 30 CFR 250 shall be made available for public inspection, as specified below, in the Area office, Metairie, Louisiana.

A. Form 9-152 - Monthly Report of Operations. All information contained on this form shall be available except the information required in the Remarks column.

B. Form 9-330 - Well Completion or Recompletion Report and Log. (1) Prior to commencement of production all information contained on this form shall be available except Item 1a, Type of Well; Item 4, Location of Well, At top prod. interval reported below; Item 22, if Multiple Compl., How many; Item 24, Producing Interval; Item 26, Type Electric and Other Logs Run; Item 28, Casing Record; Item 29, Liner Record; Item 30, Tubing Record; Item 31, Perforation Record; Item 32, Acid, Shot, Fracture, Cement Squeeze, etc.; Item 33, Production; Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

(2) After commencement of production all information shall be available except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers.

(3) If production has not commenced after an elapsed time of five years from the date of filing Form 9-330 as required in 30 CFR 250.38(b), all information contained on this form shall be available except Item 37, Summary of Porous Zones; and Item 38, Geologic Markers. Within 90 days prior to the end of the five-year period the lessee or operator may submit objections to the release of such information. The supervisor, taking into consideration the objections of the lessee, proximity to unleased lands, and the best interests of the United States, may determine that such information shall not be released.

C. Form 9-331 - Sundry Notices and Report on Wells. (1) When used as a "Notice of Intention to" conduct operations, all information contained on this form shall be available except Item 4, Location of Well, At top prod. interval; and Item 17, Describe Proposed or Completed Operations.

(2) When used as a "Subsequent Report of" operations, and after commencement of production, all information contained on this form shall be available except information under Item 17 as to subsurface locations and measured and true vertical depths for all markers and zones not placed on production.

D. Form 9-331C - Application for Permit to Drill, Deepen or Plug Back. All information contained on this form, and location plat attached thereto, shall be available except Item 4, Location of Well, At proposed prod. zone; and Item 23, Proposed Casing and Cementing Program.

E. Sales of Lease Production. Information contained on monthly Geological Survey computer printout showing sales of production of oil, condensate, gas and liquid products, by lease, shall be made available.

2. Filing of Reports. All reports on Forms 9-152, 9-330, 9-331, and 9-331C shall be filed in accordance with the following:

A. All reports submitted on these forms after the effective date of this Order shall be filed in two separate sets. All items on the forms in one set shall be completed in full and such forms, and all attachments thereto, shall not be available for public inspection. The additional set shall be completed in full, except that the items described in 1.(A), (B), (C), and (D) above, and the attachments relating to such items, may be excluded. The words "Public Information" shall be shown on the lower right-hand corner of this set. This additional set shall be made available for public inspection.

B. Copies of reports on these forms which were filed between December 1, 1970, and the effective date of this Order, shall be resubmitted (in duplicate or triplicate, as provided by

the regulations) within 30 days after the effective date of this Order. These reports may exclude the items described in 1. (A), (B), (C), and (D) above, and shall show the words "Public Information" on the lower right-hand corner and shall be made available for public inspection.

3. Availability of Records Filed Prior to December 1, 1970. Information filed prior to December 1, 1970, on the forms referred to in (1) above, is not in a form which can be readily made available for public inspection. Requests for information on these forms shall be submitted to the supervisor in writing and shall be made available in accordance with 43 CFR Part 2.

Robert F Evans

Robert F. Evans
Supervisor

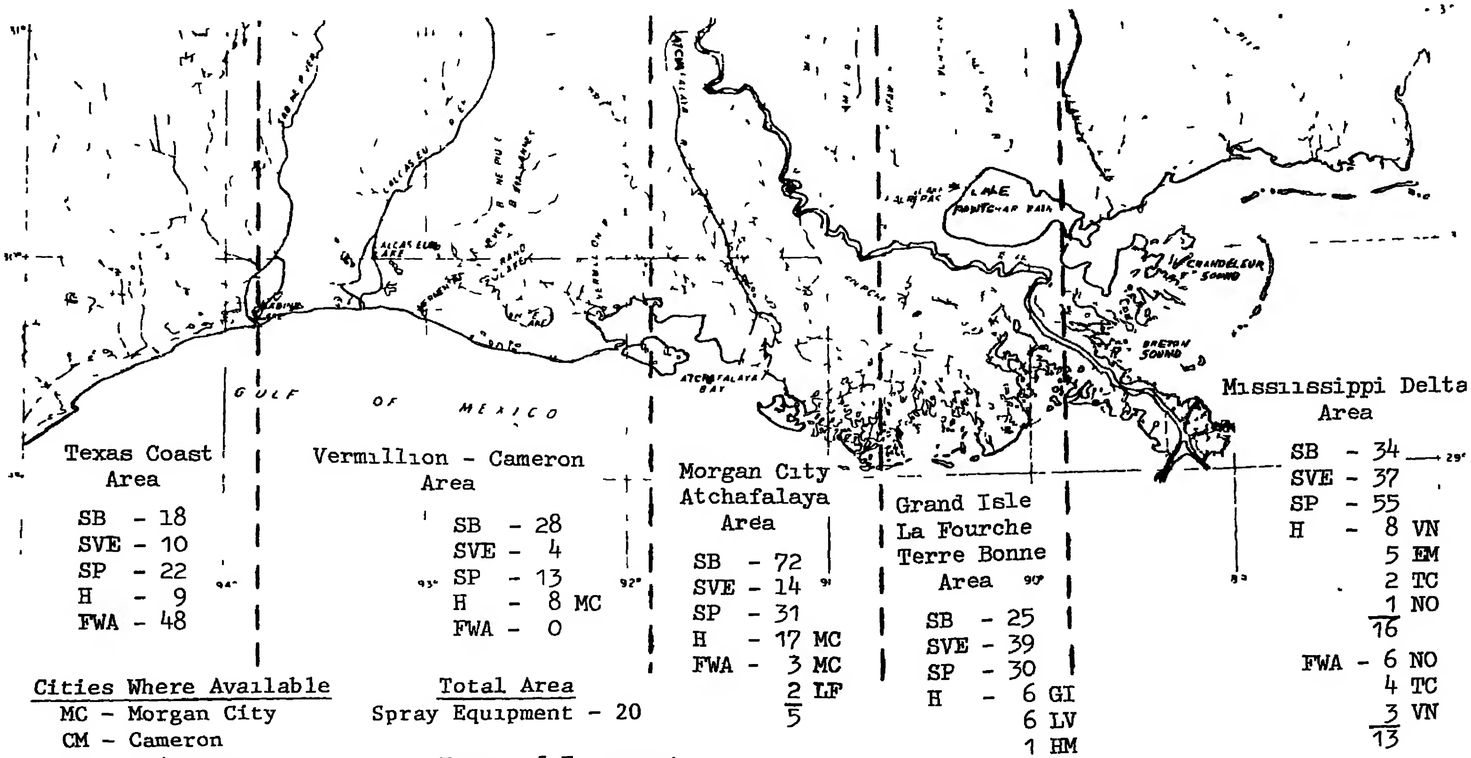
Approved: August 13, 1971

Russell G. Wayland

Russell G. Wayland
Chief, Conservation Division

ATTACHMENT H

EQUIPMENT AVAILABLE FOR EMERGENCY
OIL SPILL CONTROL AND CLEANUP
IN THE GULF OF MEXICO



Cities Where Available

MC - Morgan City
CM - Cameron
LF - Lafayette
GI - Grand Isle
LV - Leeville
HM - Houma
DL - Dulac
VN - Venice
EM - Empire
TC - Toca
NO - New Orleans

Total Area

Spray Equipment - 20

Types of Equipment

SB - Service Boats
SVE - Skimmer & Vacuum Equip.
H - Helicopters
FWA - Fixed Wing Aircraft
SP - Spill Booms

SCALE

50 0 50 100 150 MILES

ATTACHMENT I

Table 1. List of Persons Who Submitted Oral and/or Written Testimony at the Public Hearing Held in Houston, Texas - February 21 and 22, 1973 (Not necessarily in order of appearance)

	Name	Agency, Organization, or Individual
	February 21, 1973	
1.	Hon. Charles G. Purnell	Exec. Asst. to Governor Briscoe, State of Texas
2.	Hon. Clint Pray	Asst. to Governor Edwards of Louisiana
3.	Hon. A. R. "Babe" Schwartz	State Senator, Texas, Ch., Tex. Cncl. Marine-Rel. Affairs
4.	Hon. Bob Armstrong	Commissioner, General Land Office, State of Texas
5.	Hon. Byron Tunnel	Commissioner, Texas State Railroad Commission
6.	Hon. R. T. Sutton	Commissioner, La. Dept. of Conservation
7.	Dr. Lyle St. Amant	Asst. Director, La. Dept. of Wildlife and Fisheries
8.	Donald Moore	Area Supv., National Marine Fisheries Service, Galveston
9.	Dr. W. L. Fisher	Bureau of Economic Geology, State of Texas
10.	Dr. Herbert Grubb	Director of Information Servies, State of Texas
11.	Clarence T. Breaux	Dept. of Commerce and Industry, State of Louisiana
12.	George H. Lawrence	V. P. & Director, Govt. Rel. & Srvc., American Gas Assoc.
13.	Robert R. Herring	President, Houston Natural Gas Corporation

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Table 1. (cont') page 2.

Name	Agency, Organization, or Individual
February 21, 1973	
14. Bernard Sakowitz	Chairman of Board, Houston Chamber of Commerce
15. Robert Alderdice	V.P., Education Div., Galveston Chamber of Commerce
16. Dr. Richard A. Geyer	Head, Dept. of Oceanography, Texas A & M University
17. Putnam K. Reiter	Society of Independent Professional Earth Scientists
18. Charles D. Matthews	President, National Ocean Industries Association
19. Dr. William E. Sweet, Jr.	Research Assoc., Dept. of Oceanography, Texas A & M Univ.
20. Brad Messer	Galveston Daily News
21. C. H. Adams	Manager of Exploration, Cities Service Oil Company
22. K. R. Joynt	Vice President, Mobile Oil Corporation
23. Ray A. McIntyre	Asst. Secy. & Atty., Southern Natural Gas Company
24. Hon. Bernis Sadler	Mayor, Port Arthur, Texas
25. Col. John Unverferth	City Manager, City of Galveston
26. Jerry Jones	Cameron Parish Policy Jury
27. Dow Wynn	Port Director, Port of Port Arthur, Texas
28. John W. Simmons	Exec. V.P. & General Manager, Sabine River Authority of Texas

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Name	Agency, Organization, or Individual
February 21, 1973	
29. William McCollam	Pres. & Ch. Ex. Off., NOPSI, New Orleans C of C
30. L. Wilson Trahin	Exec. V.P., Morgan City Area Chamber of Commerce
31. Art Spencer	Exec. V.P., Chambers of Commerce for Beaumont, Orange and Port Arthur
32. Henry O. Gossett, Jr.	President, Gossett Oil Company, Rep. East Texas C of C
33. Edward H. Harte	Editor & Publisher, Corpus Christi, "Caller-Times"
34. Dr. Joseph Tyson	Asst. Prof. Biol. Oceanography (GURC)
35. Dr. Thomas J. Bright	Asst. Prof. of Biological Oceanography, Texas A & M Univ.
36. Roland Trosclair	Trosclair Canning Company
37. Dr. Hans A. Suter	Private Citizen, Corpus Christi, Texas
38. Dr. Alan Lohse	Gulf Coast Association of Geological Societies
39. Dr. S. Harold Reuter	Houston Underwater Club
40. A. Carl Polk	President, Dow Chemical Company
41. James E. Wilson	President, American Assoc. of Petroleum Geologists
42. Allen R. Stern	President, Burmah Oil Development, Inc.
43. William P. Heineman	Vice President, United Gas Pipeline Co.

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	Name	Agency, Organization, or Individual
	February 21, 1973	
44.	R. J. O'Brien	General Manager, Offshore Division, Shell Oil Company
45.	James E. Coventon	Asst. to V.P., Transcontinental Gas Pipe Line Corporation
46.	R. F. Young	Asst. Land Manager, TransOcean Oil, Inc.
47.	A. J. Willis	Dist. Mgr., Southern Dist., Phillips Petroleum Company
48.	Ray Lemmon	Business Man, Austin, Texas
49.	G. B. Bennett	Vice President, Florida Gas Transmission Company
50.	Hon. R. C. Gusmann	Mayor, Bay City, Texas
51.	Chet Brooks	Senator, State of Texas - Representing Five State Senators from Harris County, Texas
52.	Thomas J. Joyce	Chief, Bureau of Natural Gas, Federal Power Commission
	February 22, 1973	
53.	Austin W. Lewis	Attorney, Offshore Operators Committee
	E. O. Bell	Offshore Operators Committee
	Glen Burroughs & R. Eckhart	Offshore Operators Committee
	Bob G. Murphy	Offshore Operators Committee
	Dr. Maurice Ewing	Offshore Operators Committee
	Dr. Willis Pequegnat	Offshore Operators Committee
	Dr. Sammy M. Ray	Offshore Operators Committee
54.	Dr. John McKetta	University of Texas
55.	H. E. Rowe	Chairman, Offshore Pipeline Committee

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	Name	Agency, Organization, or Individual
	February 22, 1973	
56.	Dr. John T. McGinnis	Battelle Columbus Laboratories
57.	Carroll D. Hudson	Operations Mgr., Atlantic Richfield, Company
58.	Jerome J. McGrath	V.P. & Gen. Counsel, Independent Natural Gas Assoc. of America
59.	Nugent Brasher, Jr.	Outdoor Writer & Geologist, Lafayette Area Sportsmen
60.	Hon. Louie Welch	Mayor, City of Houston, Texas
61.	Fentress Bracewell	Chairman, Port of Houston Authority
62.	Joe Brigance	Commissioner, Brazoria County
63.	Hon. Alton C. Arnold	County Judge, Brazoria County
64.	George Wilkerson	Business Man, Cameron, Louisiana
65.	Julian Taylor	Brazosport Chamber of Commerce
66.	Jack Walker	President, Bay Shore Rod, Reel & Gun Club
67.	Robert G. Mauermann	Executive Dir., Texas Shrimp Assoc.
68.	R. W. Bybee	Exxon Company, U.S.A.
69.	James W. Dunlop	Manager, Rate Dept., Brooklyn Union Gas Company
70.	Richard C. Dixon	Sr. Vice President, Panhandle Eastern Pipeline Company
71.	John R. Suman, Jr.	Chairman of the Board, Liquid Products Recovery, Inc.

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Name	Agency, Organization, or Individual
February 22, 1973	
72. Earle D. Goss	Attorney, United Distribution Companies

AMERICAN NATURAL GAS SYSTEM
Michigan Consolidated Gas Co.
Wisconsin Gas Company

CENTRAL ILLINOIS PUBLIC SERVICE CO.

COLUMBIA GAS SYSTEM
Columbia Gas of Kentucky, Inc.
Columbia Gas of Maryland, Inc.
Columbia Gas of New York, Inc.
Columbia Gas of Ohio, Inc.
Columbia Gas of Pennsylvania, Inc.
Columbia Gas of Virginia, Inc.
Columbia Gas of W. Virginia, Inc.
Ohio Valley Gas Company

NIAGARA MOHAWK POWER CORP.

NORTHERN ILLINOIS GAS CO.

ORANGE & ROCKLAND UTILITIES, INC.

CONSOLIDATED NATURAL GAS SYSTEM
Consolidated Gas Supply Corp.
The East Ohio Gas Company
The Peoples Natural Gas Co.
The River Gas Company
West Ohio Gas Company

CONSUMERS POWER COMPANY

THE DAYTON POWER AND LIGHT CO.

EQUITABLE GAS COMPANY

ILLINOIS POWER COMPANY

INDIANA GAS COMPANY

MICHIGAN GAS UTILITIES CO.

Name	Agency, Organization, or Individual
February 22, 1973	
United Distribution Companies (cont')	
NATIONAL FUEL GAS SYSTEM Iroquois Gas Corporation Pennsylvania Gas Company United Natural Gas Company	
SOUTH CAROLINA ELECTRIC & GAS COMPANY	
CITIZENS GAS AND COKE UTILITY	
PEOPLES GAS COMPANIES North Slope Gas Company The Peoples Gas Light & Coke Co.	
73. T. J. Burnett, Jr.	Landman, The La. Land & Exploration Company
74. Jerry E. Chiles	Western Oceanic
75. R. R. Rieke	Vice President, Schlumberger Offshore Services
76. Roland Powell	Manager of Domestic Service Sales, Byron Jackson, Inc.
77. S. Orlofsky	Senior Vice Pres. & Director, Columbia Gas System Service, Corp.
78. J. B. Simpson	Sr. V.P., Consumers Power Co., P. & Dir., Northern Michigan Exploration Co., and, V.P. & Director, Michigan Gas Storage Co.
79. Joseph P. Thomas	V.P., The Peoples Gas Light & Coke Co.
80. Richard T. Hansen	Dir. of Gas Rates, City of Indianapolis, Indiana doing business with the name as Citizens Gas and Coke Utility
81. George T. Jones	Asst. V.P., Supply of Northern Illinois Gas Co.
82. R. E. Killian	Domestic Oil Field Services, Baroid Div., National Industries

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Table 2. List of Persons Who Submitted Written Testimony for Inclusion in the Hearing Record

Agency, Organization, or Individual

1. Hon. Bill Archer, U. S. Congressman - 7th District of Texas
2. Hon. Olin E. Teague, U. S. Congressman - 6th District of Texas
3. Senator Lloyd Bentsen, Texas
4. Hon. Bob Price, U. S. Congressman - 17th District of Texas
5. Senator John Tower, Texas
6. Hon. John Young, U. S. Congressman - 14th District of Texas
7. Hon. Bob Casey, U. S. Congressman - 22nd District of Texas
8. Hon. Ray Roberts, U. S. Congressman - 4th District of Texas
9. Hon. Richard C. White, U. S. Congressman - 16th District of Texas
10. The Cincinnati Gas & Electric Company
11. The Galveston Daily News
12. Houston Audubon Society, Margaret P. Sullivan, Pres.
13. East Texas Chamber of Commerce, James A. Wilson, Pres.
14. Corpus Christi Chamber of Commerce, Jack Modesett, Pres.
15. Alvin Chamber of Commerce, Alvin, Texas, Andy Zumwatt, Pres.
16. M. L. Ross, M. D., Mayor, City of Galveston
17. Southern Connecticut Gas Company, Richard Bowerman, Chairman of the Board

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Table 2. (cont')

18. Commissioner's Court of Brazoria County, Texas, Alton C. Arnold, County Judge

19. Florida Public Utilities Company, G. O. Jeranld, V. Pres., Opera.

20. Northern Illinois Gas Company, Thomas B. Miller (for G. T. Jones)

21. Brazosport Chamber of Commerce, George Kraming, President

22. City of Baytown, Texas - (City Council Resolution) Neel Richardson, City Attorney

23. Bruce Smith, independent oil operator

24. Southern Gas Association, R. R. Suttle, Managing Director

25. Brazos River Harbor Navigation District, Marcus Weems, Chairman

26. Greater Texas City, La Marque Chamber of Commerce

27. Alvin City Council, Alvin, Texas, Allen Gray, Mayor

28. Statement of State Senators Representing Harris County, Texas

29. City Council of Palacios, Texas

30. South Texas Chamber of Commerce, J. A. Cypher, Jr., Pres.

31. International Assoc. of Geophysical Contractors, Carl H. Savit, Pres.

32. Marathon Oil Co., G. R. Schoonmaker, V. Pres., Exploration

33. Wisconsin Natural Gas, John G. Quale, Pres.

34. Bay City Chamber of Commerce, Billy Joe Thomas, Ex. V. Pres.

35. City Council of Freeport, Texas, T. C. Selman, Mayor

36. City of Lafayette, Kenneth R. Bowen, Mayor

37. Lafayette Chamber of Commerce, Board of Directors

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38. Providence Gas Co., Louis R. Hampton, Pres.

39. Houston Assoc. of Petroleum Landmen, W. M. Kennedy, Pres.

40. Pennzoil Offshore Gas Operators, Inc., W. A. Hover, Pres.

41. Joseph P. Mueller, Petroleum Engineer

42. Halliburton Services, D. G. Wolff, Southern Region Counsel

43. Eastman Whipstock, Inc., R. E. Brumley, Pres.

44. Keplinger & Associates, Inc., W. R. Brinkoeter, V. Pres.

45. Clementson Engineering Co., R. C. Clementson

46. Frank S. Warner, Petroleum Consultant

47. IMCO Services, R. C. Rockwell, V. Pres.

48. IMCO Services, Ralph Murphy, V. Pres.

49. Christensen Diamond Products Co., Wayman R. Eustace
Regional Manager

50. Milchem Incorporated, William C. Norvell, Jr., Patent Counsel

51. Scientific Software Corporation, Chapman Cronquist,
Senior Consultant

52. Fluor Corporation, M. A. Ellsworth, Pres.

53. Arthur G. McKee & Co., F. G. Palcanis, General Sales Manager

54. The Ralph M. Parsons Co., Milton Lewis, Pres.

55. The Analysts, Inc., M. E. McCutchan, Pres.

56. Petroleum Management International, Inc., C. E. DeWitt

57. Core Laboratories, Inc., John D. Wisenbaker, Pres.

58. Directional Engineers, Inc., O. R. Jorden, Pres.

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59. Vermilion Parish Police Jury, Marcus A. Broussard, Sec'y Treasurer

60. American Assoc. of Petroleum Landmen, Wesley H. Mowery, Exec. Vice Pres.

61. Glendening & Schmid Law Offices for New England Distributors

62. Fitchburg Gas & Electric Co., Robert T. Kyle, V. Pres.

63. Springfield Gas Light Co., Robert T. Kyle, V. Pres.

64. Houston Geological Society, John J. Amaruso, Pres.

65. Hamilton Bros. Oil Co., D. G. Whitaker, V. Pres.

66. William Barber, Representative of Citizen's Environ. Coalition of Houston

67. Northern Indiana Public Service Co., E. M. Shorb, Admin. Asst.

68. Boston Gas, James S. Parkhill, Jr., V. Pres.

69. Michigan Wisconsin Pipe Line Co., J. J. Trebicott, Exec. V. Pres.

70. The First National Bank of Bay City (Texas), E. L. McDonald, Pres.

71. Gulf Oil Corp., Ernest L. Petree, V. Pres.

ATTACHMENT J

Form 3100-1
(February 1971)
(formerly 3380-1)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

OIL AND GAS LEASE OF SUBMERGED LANDS
UNDER THE OUTER CONTINENTAL SHELF LANDS ACT

Office	
Serial Number	
Cash Bonus	
Rental Rate	
Minimum Royalty Rate	Royalty Rate

This lease is made and effective as of (hereinafter called the Effective Date) by and between the United States of America (hereinafter called the Lessor) by the Bureau of Land Management its authorized officer and

(hereinafter called the Lessee) In consideration of the cash payment heretofore made by the Lessee to the Lessor and in consideration of the promises terms conditions and covenants contained herein the parties hereto agree as follows

Sec 1 Statutes and Regulations This lease is made pursuant to the Outer Continental Shelf Lands Act of August 7 1953 (67 Stat 462 43 U S C Secs 1331 *et seq*) (hereinafter called the Act) This lease is subject to all the provisions of the Act and to all the terms conditions and requirements of the valid regulations promulgated by the Secretary of the Interior (hereinafter called the Secretary) thereunder in existence upon the effective date of this lease all of which are incorporated herein and by reference made a part hereof This lease shall also be subject to regulations hereafter issued by the Secretary pursuant to his authority under section 5(a)(1) of the Act to prescribe and amend at any time such rules and regulations as he may determine to be necessary and proper in order to provide for the prevention of waste and for the conservation of the natural resources of the Outer Continental Shelf and for the protection of correlative rights therein which regulations shall be deemed incorporated herein and by reference made a part hereof when promulgated

Sec 2 Rights of Lessee The Lessor hereby grants and leases to the Lessee the exclusive right and privilege to drill for mine extract remove and dispose of oil and gas deposits except helium gas in or under the following described area of the Outer Continental Shelf of the United States

containing approximately acres (hereinafter referred to as the leased area) together with

(a) the nonexclusive right to conduct within the leased area geological and geophysical explorations in accordance with applicable regulations

(b) the nonexclusive right to drill water wells within the leased area and to use water produced therefrom for operations pursuant to the Act free of cost provided that such drilling is conducted in accordance with procedures approved by the Regional Oil and Gas Supervisor of the Geological Survey (hereinafter called the 'Supervisor) and

(c) the right to construct or erect and to maintain within the leased area all artificial islands platforms fixed or floating structures sea walls docks dredged channels and spaces buildings plants telegraph or telephone lines and cables pipelines reservoirs tanks pumping stations and other works and structures necessary to the full enjoyment of the rights granted by this lease subject to compliance with applicable laws and regulations

Sec 3 Obligations of Lessee The Lessee agrees

(a) *Rentals and royalties* (1) To pay rentals and royalties as follows

Rentals With respect to each lease year commencing prior to a discovery of oil or gas on the leased area to pay the Lessor on or before the first day of each such year a rental of per acre or fraction thereof

Minimum royalty To pay the Lessor at the expiration of each lease year commencing after discovery a minimum royalty of per acre or fraction thereof or if there is production the difference between the actual royalty required to be paid with respect to such lease year and the prescribed minimum royalty if the actual royalty paid is less than the minimum royalty

Royalty on production To pay the Lessor a royalty of percent in amount or value of production saved removed or sold from the leased area Gas of all kinds (except helium and gas used for purposes of production from and operations upon the leased area or unavoidably lost) is subject to royalty

(2) It is expressly agreed that the Secretary may establish minimum values for purposes of computing

royalty on products obtained from this lease, due consideration being given to the highest price paid for a part or for a majority of production of like quality in the same field, or area, to the price received by the Lessee, to posted prices, and to other relevant matters Each such determination shall be made only after due notice to the Lessee and a reasonable opportunity has been afforded the Lessee to be heard

(3) When paid in value, royalties on production shall be due and payable monthly on the last day of the month next following the month in which the production is obtained When paid in production, such royalties shall be delivered at pipeline connections or in tanks provided by the Lessee Such deliveries shall be made at reasonable times and intervals and, at the Lessor's option, shall be effected either (i) on or immediately adjacent to the leased area without cost to the Lessor, or (ii) at a more convenient point closer to shore or on shore, in which event the Lessee shall be entitled to reimbursement for the reasonable cost of transporting the royalty substance to such delivery point The Lessee shall not be required to provide storage for royalty taken in kind in excess of tankage required when royalty is paid in value When payments are made in production the Lessee shall not be held liable for the loss or destruction of royalty oil or other liquid products in storage from causes over which the Lessee has no control

(b) *Bonds* To maintain at all times the bond required prior to the issuance of this lease and to furnish such additional security as may be required by the Lessor if, after operations or production have begun, the Lessor deems such additional security to be necessary

(c) *Wells* (1) To diligently drill and produce such wells as are necessary to protect the Lessor from loss by reason of production on other properties or, in lieu thereof with the consent of the Supervisor, to pay a sum determined by the Supervisor as adequate to compensate the Lessor for failure to drill and produce any such well In the event that this lease is not being maintained in force by other production of oil or gas in paying quantities or by other approved drilling or reworking operations such payments shall be considered as the equivalent of production in paying quantities for all purposes of this lease

(2) After due notice in writing to diligently drill and produce such other wells as the Secretary may reasonably require in order that the leased area or any part thereof may be properly and timely developed and produced in accordance with good operating practice

(3) At the election of the Lessee to drill and produce other wells in conformity with any system of well spacing or production allotments affecting the area, field or pool in which the leased area or any part thereof is situated which is authorized or sanctioned by applicable law or by the Secretary

(d) *Payments* To make all payments to the Lessor by check bank draft or money order payable as indicated herein unless otherwise provided by regulations or by direction of the Secretary Rental, royalties, and other payments shall be made payable to the United States Geological Survey and tendered to the Supervisor *except* that filing charges, bonuses and first year's rental shall be made payable to the Bureau of Land Management and remitted to the Manager of the appropriate field office of that Bureau

(e) *Inspection* To keep open at all reasonable times for the inspection of any duly authorized representative of the Lessor, the leased area and all wells, improvements, machinery and fixtures thereon and all books, accounts, and records relative to operations and surveys or investigations on or with regard to the leased area or under the lease

(f) *Conduct of operations* To conduct all operations under this lease in accordance with applicable law and regulations

(g) *Indemnification* To indemnify and save the Lessor harmless against and from any and all claims of any nature whatever, including without limitation claims for loss or damage to property or injury to persons, caused by, or resulting from, any operation on the leased area conducted by or on behalf of the Lessee, provided that the Lessee shall not be held responsible to the Lessor under this subsection for any loss, damage, or injury caused by, or resulting from (1) any negligent action of the Lessor other than the exercise or performance of (or the failure to exercise or perform) a discretionary function or duty on the part of a Federal agency or an employee of such an agency, whether or not the discretion involved is abused, or (2) the Lessee's compliance with an order or directive of the Lessor against which an appeal by the Lessee under 30 CFR 250 81 is filed before the cause of action for such a claim arises and is pursued diligently thereafter

(h) *Equal Opportunity Clause* The Lessee agrees that, during the performance of this lease

(1) The Lessee will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin The Lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin Such action shall include, but not be limited to the following employment, upgrading, demotion, or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training including apprenticeship The Lessee agrees to post in conspicuous places available to employees and applicants for employment, notices to be provided by the Lessor setting forth the provisions of this Equal Opportunity clause

(2) The Lessee will, in all solicitations or advertisements for employees placed by or on behalf of the Lessee, state that all qualified applicants will receive consideration for employment without regard to race color religion sex or national origin

(3) The Lessee will send to each labor union or representative of workers with which Lessee has a collective bargaining agreement or other contract or understanding a notice to be provided by the Lessor, advising the labor union or workers' representative of the Lessee's commitments under this Equal Opportunity clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment

(4) The Lessee will comply with all provisions of Executive Order No 11246 of September 24 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor

(5) The Lessee will furnish all information and reports required by Executive Order No 11246 of September 24, 1965, as amended, and by the rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the Secretary of the Interior and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders

(6) In the event of the Lessee's noncompliance with the Equal Opportunity clause of this lease or with any of said rules regulations, or orders, this lease may be canceled, terminated or suspended in whole or in part and the Lessee may be declared ineligible for further Federal government contracts or leases in accordance with procedures authorized in Executive Order No 11246 of September 24, 1965, as amended, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No 11246 of September 24, 1965, as amended or by rule regulation or order of the Secretary of Labor, or as otherwise provided by law

(7) The Lessee will include the provisions of Paragraphs (1) through (7) of this subsection 3(h) in

every contract subcontract or purchase order unless exempted by rules regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order No 11246 of September 24 1965 as amended so that such provisions will be binding upon each contractor, subcontractor or vendor The Lessee will take such action with respect to any contract, subcontract or purchase order as the Secretary may direct as a means of enforcing such provisions including sanctions for noncompliance *provided however* that in the event the Lessee becomes involved in or is threatened with litigation with a contractor, subcontractor or vendor as a result of such direction by the Secretary, the Lessee may request the Lessor to enter into such litigation to protect the interests of the Lessor

(i) *Certification of nonsegregated facilities* By entering into this lease the Lessee certifies that Lessee does not and will not maintain or provide for Lessee s employees any segregated facilities at any of Lessee's establishments and that Lessee does not and will not permit Lessee's employees to perform their services at any location under Lessee s control where segregated facilities are maintained The Lessee agrees that a breach of this certification is a violation of the Equal Opportunity clause in this lease As used in this certification, the term "segregated facilities means, but is not limited to, any waiting rooms, work areas rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas parking lots drinking fountains recreation or entertainment areas transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race color, religion or national origin because of habit, local custom or otherwise Lessee further agrees that (except where Lessee has obtained identical certifications from proposed contractors and subcontractors for specific time periods) Lessee will obtain identical certifications from proposed contractors and subcontractors prior to the award of contracts or sub contracts exceeding $10 000 which are not exempt from the provisions of the Equal Opportunity clause that Lessee will retain such certifications in Lessee s files and that Lessee will forward the following notice to such proposed contractors and subcontractors (except where the proposed contractor or subcontractor has sub mitted identical certifications for specific time periods) Notice to prospective contractors and subcontractors of requirement for certification of nonsegregated facilities A Certification of Nonsegregated Facilities as required by the May 9 1967 order (32 F R 7439 May 19 1967) on Elimination of Segregated Facilities by the Secretary of Labor must be submitted prior to the award of a contract or subcontract exceeding $10 000 which is not exempt from the provisions of the Equal Opportunity clause The certification may be submitted either for each contract and subcontract or for all contracts and subcontracts during a period (i e quarterly, semiannually, or annually)

(j) *Assignment of lease* To file for approval with the appropriate office of the Bureau of Land Management any instrument of transfer of this lease or any interest therein required to be filed under applicable regulations, within the time and in the manner prescribed by the applicable regulations

Sec 4 Term This lease shall continue for a period of 5 years from the effective date of this lease and so long thereafter as oil or gas may be produced from the leased area in paying quantities, or drilling or well reworking operations, as approved by the Secretary, are conducted thereon

Sec 5 Cooperative or Unit Plan Lessee agrees that, within 30 days after demand by Lessor Lessee will subscribe to and operate under such cooperative or unit plan for the development and operation of the area, field, or pool, or part thereof, embracing lands subject to this lease as the Secretary may determine to be practicable and necessary or advisable in the interest of conservation Where any provision of a cooperative or unit plan of development which has been approved by the Secretary and which by its terms affects the leased area or any part thereof, is inconsistent with a provision of this lease, the provision of such cooperative or unit plan shall govern

Sec 6 Reservations to Lessor All rights in the leased area not expressly granted to the Lessee by the Act the regulations, or this lease are hereby reserved to the Lessor Without limiting the generality of the foregoing, such reserved rights include

(a) *Geological and geophysical exploration rights of way* The right to authorize the conduct of geological and geophysical exploration in the leased area which does not interfere with or endanger actual operations under this lease and the right to grant such easements or rights-of-way upon through, or in the leased area as may be necessary or appropriate to the working of other lands or to the treatment and shipment of products thereof by or under authority of the United States its Lessees or Permittees

(b) *Leases of sulfur and other minerals* The right to grant leases of any mineral other than oil and gas within the leased area or any part thereof No lease of other mineral shall authorize or permit the Lessee thereunder unreasonably to interfere with or endanger operations under this lease

(c) *Purchase of production* In time of war, or when the President of the United States shall so prescribe, the right of first refusal to purchase at the market price all or any portion of the oil or gas produced from the leased area, as provided in Section 12(b) of the Act

(d) *Taking of royalties* The right to determine whether royalty will be taken in the amount or the value of production

(e) *Helium* Pursuant to Section 12(f) of the Act the ownership of and the right to extract helium from all gas produced under this lease

(f) *Suspension of operations during war or national emergency* Upon recommendation of the Secretary of Defense during a state of war or national emergency declared by the Congress or President of the United States after August 7 1953 the authority of the Secretary to suspend any or all operations under this lease as provided in Section 12(c) of the Act *Provided* That just compensation shall be paid by the Lessor to the Lessee

(g) *Restriction of exploration and operations* The right as provided in Section 12(d) of the Act to restrict from exploration and operations the leased area or any part thereof which may be designated by and through the Secretary of Defense with the approval of the President as or as part of an area of the Outer Continental Shelf needed for national defense and so long as such designation remains in effect no exploration or operations may be conducted on the surface of the leased area or the part thereof included within the designation except with the concurrence of the Secretary of Defense and if operations or production under this lease within any such restricted area shall be suspended any payments of rentals and royalty prescribed by this lease likewise shall be suspended during such period of suspension of operations and production, and the term of this lease shall be extended by adding thereto any such suspension period, and the Lessor shall be liable to the Lessee for such compensation as is required to be paid under the Constitution of the United States

Sec 7 Directional Drilling A directional well drilled under the leased area from a surface location on nearby land not covered by this lease shall be deemed to have the same effect for all purposes of this lease as a well drilled from a surface location on the leased area In such circumstances, drilling shall be considered to have

been commenced on the leased area when drilling is commenced on the nearby land for the purpose of directional drilling under the leased area, and production of oil or gas from the leased area through any directional well [illegible] land [illegible] drilling or reworking of [illegible] shall be considered production or drilling or reworking operations, as the case may be, on the leased area for all purposes of this lease. Nothing contained in this paragraph is intended or shall be construed as granting to the Lessee any leasehold interests [illegible] leases, easements, or other rights in or with respect to any such nearby land in addition to any such leasehold interests, licenses, easements or other rights which the Lessee may have lawfully acquired under the Act or from the Lessor or others.

Sec. 8. Surrender of Lease. The Lessee may surrender this entire lease or any officially designated subdivision of the leased area by filing with the appropriate office of the Bureau of Land Management a written relinquishment [illegible] which shall be effective as of the date of filing. No surrender of this lease or of any portion of the leased area shall relieve the Lessee or his surety of the obligation to make payment of all accrued rentals and royalties or to abandon all wells on the area to be surrendered in a manner satisfactory to the Supervisor.

Sec. 9. Removal of property on termination of lease. [illegible] this lease in whole or in part [illegible] the lease in whole or in part as herein provided the Lessee shall [illegible] a period of 1 year [illegible] the premises no longer sub[illegible] lease [illegible] equipment [illegible] applicable regulations and orders [illegible] the Supervisor [illegible] the Lessee [illegible] may be needed [illegible] leases

Sec. [illegible] Remedies in case of default. (a) Whenever the Lessee [illegible] cancellation in accordance with the provisions of Section 5(b) of the Act [illegible] that the 30-day notice provision applicable to nonproducing leases under Section 5(b)(1) of the Act shall also apply as a prerequisite to the institution of any legal action by the Lessor to cancel this lease while it is in a producing status. Nothing in this subsection shall be construed to apply to or require any notice with respect to any legal action instituted by the Lessor other than an action to cancel the lease pursuant to Section 5(b) of the Act.

(b) Whenever the Lessee fails to comply with any of the provisions of the Act or of this lease, or of any regulations promulgated by the Secretary under the Act, the Lessor may exercise any legal or equitable remedy or remedies which the Lessor may have including appropriate action under the penalty provisions of Section 5(a)(2) of the Act. However, the remedy of cancellation of the lease may be exercised only under the provisions of Section 5(b) and Section 8(i) of the Act.

(c) A waiver of any particular violation of the provisions of the Act or of this lease or of any regulations promulgated by the Secretary under the Act shall not prevent the cancellation of this lease or the exercise of any other remedy or remedies under paragraphs (a) and (b) of this section by reason of any other such violation or for the same violation occurring at any other time.

Sec. 11. Heirs and successors in interest. Each obligation hereunder shall extend to and be binding upon, and every benefit hereof shall inure to the heirs, executors, administrators, successors or assigns of the respective parties hereto.

Sec. 12. Unlawful interest. No member of, or Delegate to Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom, and the provisions of Section 3741 of the Revised Statutes (41 U.S.C. Sec. 22), as amended, and Sections 431, 432, and 433 of Title 18 of the United States Code relating to contracts made or entered into, or accepted by or on behalf of the United States, form a part of this lease so far as the same may be applicable.

THE UNITED STATES OF AMERICA

______________________ By ______________________
(Signature of Lessee) (Authorized Officer)

______________________ ______________________
(Signature of Lessee) (Title)

______________________ ______________________
(Signature of Lessee) (Date)

______________________ ______________________
(Signature of Lessee)

[illegible]